QK1
.A423
v.10
1926/27

THE AMERICAN

MIDLAND NATURALIST

DEVOTED TO NATURAL HISTORY, PRIMARILY
THAT OF THE PRAIRIE STATES

JULIUS A. NIEUWLAND, C.S.C., PH.D., SC.D.
EDITOR

VOLUME X.—1926-27

+1.50

UNIVERSITY OF NOTRE DAME
NOTRE DAME, INDIANA

MISSOURI BOTANICAL
RECEIVED
SEP 21 1928
GARDEN LIBRARY

CONTENTS

Studies in the Compositae—*Theo. Holm* ---------- 1

Botanical Gleanings in Michigan—III.—*Oliver Atkins Farwell*---19, 199

Obituary—Mark Alfred Carleton—*Theo. Holm* ---------- 47

Missouri Species of Elymus—*Benjamin Franklin Bush*---------- 49

Report on the Study and Appraisal of Mussel Resources in Selected Areas on the Upper Mississippi River, 1920-25—*N. M. Grier, Ph.D.* ---------- 89-113

Indiana Dune Plant Notes—*Donald C. Beattie* ----------129

Notes of Trees and Shrubs of Missouri—*Benjamin Franklin Bush*--133

Book Reviews ----------159, 301, 303

The Hitchcock Lecture upon Ichnology, and the Darthmouth College Ichnological Collection—*N. M. Grier* ----------161

On the Division of the Sphaeriae into two Subfamilies: and the Description of a new Genus of Unionidae, with Description of new Varieties—*Frank Collins Baker* ----------220

Some Species of Viburnum—*Benjamin Franklin Bush* ----------225

List of Flowering Plants and Ferns in the Dunes State Park and Vicinity, Porter County, Indiana—*Marcus Ward Lyon, Jr.*------245

The March Hawk—*Benjamin Franklin Bush* ----------297

Contributions to the Botany of Michigan—*Oliver Atkins Farwell*---305

The Shellrock Stage on the Devonian of Iowa—*C. H. Belanski* -----317

New Species of Aulopora from the Devonian of Iowa—*Mildred Adams Fenton* ----------373

The Species of Polygonatum—*Benjamin Franklin Bush* ----------385

A Great Blunder—*Benjamin Franklin Bush* ----------401

MISPRINTS IN "STUDIES IN THE COMPOSITAE"

January, 1926. Vol. X, No. 1.

Page 5, line 8, from below "paleaceus"
lege "paleaceous."

Page 6, line 13, from below "many"
lege "as many."

Page 9, line 15, from below "graduiflorus"
lege "gradiflorus."

Page 12, line 2, from below "broadcast"
lege "broadest."

Page 14, line 1, from above "achnia" lege "achenia."

Page 14, line 27, from below insert after middle, "as shown in the longitudinal section (Fig. 3)"

Omit from "however" up to "This" of line 31.

The American Midland Naturalist

PUBLISHED BI-MONTHLY BY THE UNIVERSITY
OF NOTRE DAME, NOTRE DAME, INDIANA

Vol. X. JANUARY, 1926. No. 1.

STUDIES IN THE COMPOSITAE.

THEO. HOLM.

I. *Krigia Virginica* (L.) Willd.

(With three plates drawn from nature by the author.)

INTRODUCTION.

The North American *Compositae* have received much attention from a taxonomic point of view, notably in the fundamental works of Asa Gray and E. L. Greene. The genera are, at present, well understood, and the species described up to the recent time offer an excellent illustration of the vastness of the family on this continent. It now remains to study the biology of these plants, and it is the writer's intention to offer some contributions to the knowledge of this particular point by means of describing the structure, and, so far as possible, to compare this with the results gained by previous authors. However, we regret to admit that our contributions will be merely fragmentary, since it is so extraordinarily difficult to obtain any large quantity of material suitable for such studies, except what is accessible to us in this vicinity; moreover the necessity of preparing the specimens in "denatured alcohol" is an obstacle, quite troublesome indeed.

The anatomy of *Compositae* covers a great field. We need only to read the synopsis of the characteristics in Solereder's "Systematische Anatomie der Dicotyledonen" to realize the magnitude of the work that has been done, and what is still to be done. We notice the immense variations of even the simple structures, combined with others of a more complicated nature such as for instance the systems of oil-ducts, and latex-tubes, the structure of the stele etc., not speaking of the singular structure of the roots, a subject, which so far, is but very imperfectly known. The anatomical litera-

ture is copious, nearly all contributed by French and German investigators.

Concerning the external morphology of the family, we know very little about this matter. The European species have been studied, but only a relatively small number of really interesting structures have been observed; the seedling-stage, for instance, is remarkably uniform, and so very many of these plants are annuals, thus the further development of the plants offers little of interest. The floral structure, as described by Eichler, comprises only a small chapter of his work "Blüthen-diagramme" as compared with a number of the other families; the morphological identity of the pappus, however, is highly interesting, and some very instructive works have been contributed notably by Samsöe Lund and Koehne. Then, but quite recently, Briquet has called attention to the carpologic structure, containing many points of interest.

But so far as concerns the North American representation of the *Compositae,* the material accessible to the European investigators was too scant to be useful for any very comprehensive treatment, and consequently there is a wide field of research open for the students on this continent.

According to Gray, *Krigia* Schreb. comprises three sections, viz., *Cymbia* Torr. et Gr. (K. *occidentalis* Nutt.), *Eukrigia* Torr. et Gr. (*K. Virginica* (L.) Willd.), and *Cynthia* (D. Don) Gray (*K. Dandelion* Nutt., *K. montana* Nutt., and *K. amplexicaulis* Nutt.) The principal distinction depends upon the two former sections being annuals, the third perennial, besides the structure of the pappus: mostly 5-paleaceous and 5-aristate in *Cymbia;* 5 to 7 roundish paleae alternating with as many capillary, long bristles in *Eukrigia;* and finally in *Cynthia*: 10 to 15 oblong paleae and 15-20 slender, capillary bristles. While *Cymbia* is acaulescent, *Eukrigia* and *Cynthia* occur both as caulescent and acaulescent. *Krigia Dandelion* (L.) Nutt. is the only species in which vegetative reproduction is secured by means of tuberiferous stolons.

Krigia Virginica thus represents a monotypic section, and it would seem natural to consider it as such judging from the external structure; some authors, however, regard it as

PLATE 1

Figure 1. Part of a plant at the aestival stage; natural size.
Figure 2. Axillary shoot from the vernal stage; enlarged.
Figure 3. Longitudinal section of the capitulum, partly schematic.
Figure 4. The pappus seen from above; enlarged.
Figure 5. Epidermis of the upper margin of the scale-like inner pappus; × 480.
Figure 6. Part of the bristle-like pappus; × 360.

a monotypic genus. The internal structure has not been studied, so far, of any of the members of *Krigia*, and if the present paper deals only with *K. Virginica*, the anatomical characteristics, which we have observed, may prove useful to some future investigator describing the anatomy of the other species. A comparative anatomical study of the genus might throw some light upon the actual position of the species, representing genera or merely sections.

The habit of *Krigia Virginica* is somewhat singular. The seeds germinate in the early spring; a rosette of leaves becomes developed, and several floral scapes appear from the axils of the leaves. Neither at the time of flowering nor of maturing the fruits is there any indication of a secondary stage to appear. The plants wither soon, and look completely dead for a month or so, until the latter part of June or early in July, when we notice the fields covered with a new vegetation of *Krigia*, abundantly flowering, but of a much taller stature, very prominently caulescent and profusely branched. It is a small part of this stage, which we have drawn, (Plate 1, figure 1), and which shows the persisting primary root, several strong, secondary roots, the vertical, very short and thick rhizome, and the basal portion of a branched stem with some heads and leaves. The foliage of the aestival stage consists of linear leaves, frequently opposite, glandular-hairy like the stems. In the vernal stage the leaves of the rosette are spatulate-obovate, entire or pinnately parted; they subtend small shoots (Fig. 2), which later on develop into tall, branched stems (Fig. 1).

While thus the habit of the vernal stage is different from that of the aestival, the structure of the capitulum and the flowers is the same in both. By Gray the involucre of the genus (*Krigia*) is described as "simple and naked, i. e., of equal bracts and no short calyculate ones at base" (Synopt. Flora of North America 2nd ed. 1888, p. 84); the involucre of the species (*K. Virginica*) is by this same author (l. c. p. 411) described as consisting of "9 to 18 bracts, thin, remaining narrow and nearly nerveless, reflexed after the fall of the akenes." Nothing is said about the bracts being arranged in two whorls, nor of the inner whorl subtending flowers. Nevertheless in the diagnosis of the family (*Com-*

positae, l. c. p. 48) Gray defines the involucre (periclinium of authors) as being "formed of separate sometimes connate reduced leaves, i. e., bracts, the innermost of these bracts subtend the outermost or lowest flowers." In other words, Gray did not restrict the term involucre to the barren bracts; the bracts subtending the disk-flowers were by Gray called "paleae, chaff, or simply bracts of the receptacle." In some few cases, however, Gray was unable to draw the distinction between the involucre and the paleae, for instance in the *Filagineae* (l. c. p. 57), where Gray speaks of: "a chaff (palea) or involucral bract enclosing or subtending each female flower or akene."

The term "involucre" has been used in two different ways: to apply to the barren bracts alone, or to include also the innermost whorl, which frequently is fertile. In the former case some genera: *Adenostyles* (*albifrons*), *Tagetes* and *Tragopogon* would have no involucre, since all the bracts subtend flowers; nevertheless these floral bracts show the general shape and structure of involucral bracts in general. This distinction originated with Cassini (1819) when he attributed "un involucre oligophylle" to *Filago*, *Gifola* and *Logfia*, describing the floral bracts as "bractées paléales." More recently Briquet* has brought the matter up again suggesting that the term involucre be reserved to the barren bracts "l'ensemble des feuilles steriles," and, bractées paléales to those subtending flowers. From a morphological viewpoint nothing is gained by accepting this terminology instead of the former, and nothing could be gained either. For the barren bracts as well as the floral, the latter, including also the paleae, chaff, or simply bracts of the receptacle, are homologous organs. It is true that the actual limit of the involucre has not been defined correctly in several cases, and that the adoption of the term paleaceus bracts would induce the Syantherologists to examine the flowers more carefully with respect to the actual position of the peripheral in proportion to the adjoining bracts. Wydler is the only author, so far, who has contributed to the knowl-

* Briquet, I. Le Critère différentiel des bractées involucrales et paléales dans la calathide des Composées. Arch. d. sc. phys. et nat. Tome 43. Genève, 1917. p. 432.

edge of this particular question in his excellent work: "Kleinere Beiträge zur Kenntniss einheimischer Gewächse (Flora, 1860)." The term "paleaceous," however, is somewhat misleading. It refers to something membranaceous as the glumes and palea in the Gramineae, as well as the chaff in the *Compositae*. But the outermost floral bracts in *Tubuliflorae* and *Liguliflorae* are in many genera of a firm structure, contain chlorenchyma and stereome like the barren bracts, and perform the same function as these, protecting the flowers, and sometimes facilitating the liberation of the fruits. It would seem more natural, we believe, not to restrict the term involucre to the barren bracts alone.

In Krigia Virginica the involucre consists of two whorls of bracts, the innermost subtending flowers. The barren bracts, from three to six, are linear and of the same length; they have a distinct midrib and several secondaries, but much thinner; capitate hairs (Fig. 7) are frequent on the dorsal face, especially near the base. The floral bracts, from four to seven, are of the same length as the barren, but they are glabrous and have broad membranaceous margins, and veiny like the others. The innermost flowers, most frequently 15, are bractless.

The achenium is narrowly turbinate, of a black color, most frequently pentangular, and hispid along the ridges. The pappus (Plate 1, fig. 4) consists most often of five hyaline, obovate paleae alternating with an inner whorl of many capillary, long bristles, at first erect, but at the maturity of the achenium horizontally spreading.

Internal structure of the vegetative organs.

The root-system. None of the numerous, secondary roots examined showed the original structure before the increase in thickness takes place. The increase has already begun, when the plant is beginning to bloom at the first stage. In the youngest roots the peripheral tissues from epidermis to endodermis were preserved, and still active. The epidermis is hairy, and there is a large-celled, contractile exodermis surrounding the cortical parenchyma, which consists of four to five strata, the cells thin-walled and very regularly arranged in radii towards the endodermis, with wide inter-

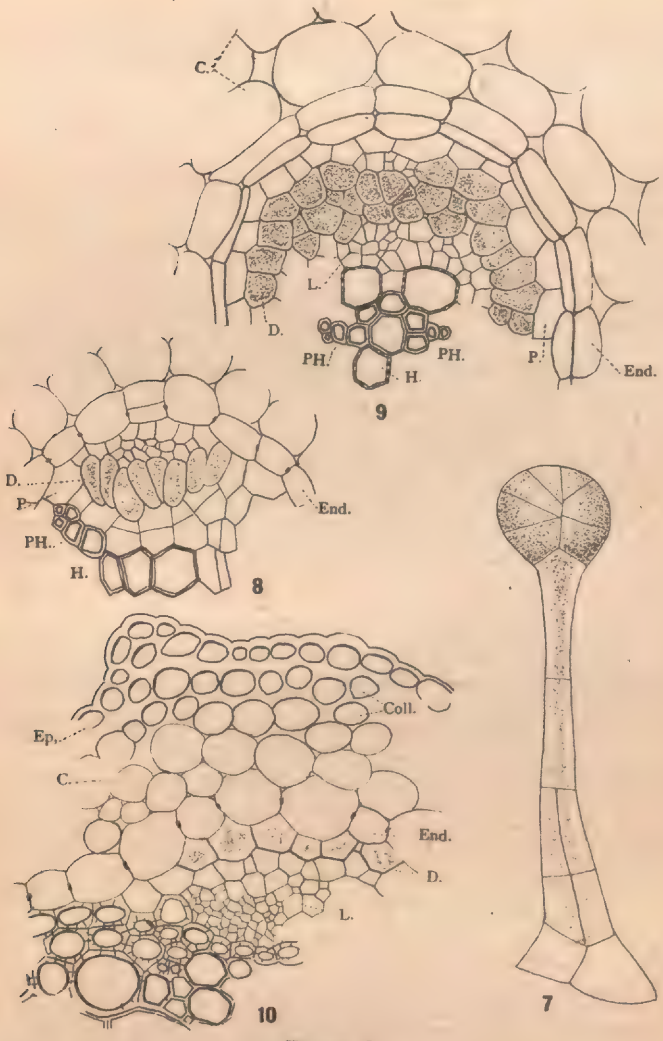


PLATE 2

Figure 7. Hair from the involucre; × 480.

Figure 8. Cross-section of a young root; End.=endodermis; P=pericambium; D=laticiferous ducts; P. H.=proto hadrome; H=secondary hadrome; ×600.

Figure 9. Cross-section of an older root; C=cortex; L=leptome; other letters as above; ×480.

Figure 10. Cross-section of a secondary scape; Ep.=epidermis; other letters as above; ×480.

cellular spaces, but with no deposits of starch. The endodermis is thin-walled, and does not contain starch (Fig. 8); the Casparyn spots are plainly visible, and, moreover, one cell outside each of the three primary leptome-strands, the root being triarch, shows a tangential division. The pericambium is thin-walled, and shows no divisions. With regard to the stele we observe (Fig. 8) on the thinner flank of the leptome a row of relatively wide laticiferous ducts, mostly seven or eight, and between these and the hadrome a meristematic tissue is visible with beginning cell-divisions. The hadrome is composed of three short rays of narrow proto-hadrome vessels extending from a central strand of about five, wide, porous vessels of secondary origin.

Characteristic of this root-structure is thus the beginning cell-division in endodermis, and the well-developed strands of latex-tubes inside the leptome.

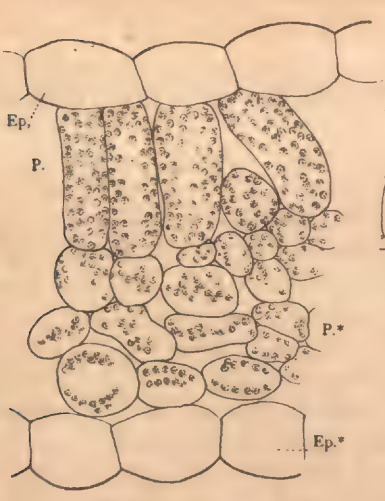
In a somewhat older root, the primary of a flowering specimen, collected early in April, the epidermis has become thrown off, replaced by the persistent exodermis; the cortex shows the same structure as described above, while the endodermis (Fig. 9) shows a tangential division in all the cells, resulting in the formation of a band of narrow, rhombic ducts corresponding with the oil-ducts of the *Tubuliflorae*, but containing no oil. The pericambium has remained intact, while the primary leptome-strands have become partly obliterated, replaced by secondary; the laticiferous tissue has increased considerably in size, forming two broad arches, separated only by a few parenchymatic strata outside the two rays of proto-hadrome; the secondary hadrome is represented by a few wide, porous vessels in the centre of the stele.

Finally, if we examine one of the thickest roots of a plant in its second stage collected in July, we observe the cortex and the endodermis to be very much compressed, while the pericambium is still intact. The laticiferous ducts, though much compressed, are readily to be distinguished as two separate arches, bordering on the pericambium, and enclosing the secondary leptome; the secondary hadrome occupies the greater portion of the stele as a compact tissue of numerous wide, porous vessels, interspersed with small strands of

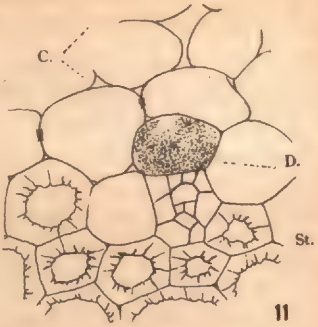
thick-walled conjunctive tissue, and obscuring the primary hadrome almost completely.

We have thus in the root-system of *Krigia* a good illustration of the progressive increase in thickness beginning with the development of secondary hadrome (Fig. 8), followed soon after by enlargement of the laticiferous tissue and development of secondary leptome (L. in fig. 9) at the expense of the primary leptome, which becomes strongly compressed and finally obliterated. At the same time the cortical parenchyma and the endodermis become compressed, and the epidermis replaced by the exodermis. The pericambium remains intact, taking no part in the increasing growth in thickness. The actual increase is thus confined to the stele. With reference to the laticiferous tissue this shows the same position as in the roots of other members of the *Liguliflorae*. Very singular and almost unique is the development of ducts by the endodermis (Figs, 8 and 9). We have seen the first appearance of these ducts as a tangential wall in one cell of the endodermis outside each of the three strands of primary leptome, and finally that the cell-division takes place throughout the endodermis, when the secondary tissues have advanced in growth. These ducts thus correspond with those that are characteristic of the *Tubuliflorae*, even if they do not contain oil. It is a structure which, so far, has only been found in a very few members of the *Liguliflorae:* some species of *Scorzonera, Scolymus graduiflorus* and *Tragopogon porrifolius* (Van Tieghem.) On the other hand, cell-divisions in the endodermis, but without forming ducts, have been observed in *Cichorium Intybus* and *Lampsana communis*.

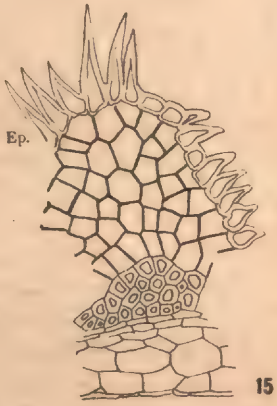
The aerial stem. The floral scape, during the first flowering (April), is almost cylindric with some, six to seven, shallow furrows, and glabrous. The cuticle is thin, smooth, and the outer cell-wall of the epidermis is slightly thickened. In the ridges the hypodermal stratum of cortex is collenchymatic, while the other, two to three, layers are thin-walled and contain chlorophyll, but no crystals; no palisade cells were observed in the cortex. There is no endodermis and no pericycle; the mestome-strands, six to seven large, and three much smaller, form a circular band, bordering inwards on



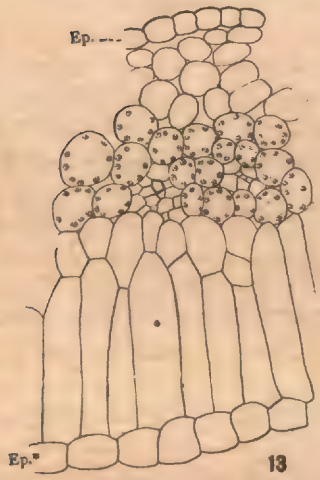
12



11



15



13

14

PLATE 3

Figure 11. Cross-section of an internode of a branched specimen; St.=sterome; other letters as above; ×840.

Figure 12. Cross-section of a leaf from the rosette; Ep.=the ventral, Ep.×=the dorsal epidermis; P=the palisade, P×=the pneumatic tissue; × 480.

Figure 13. Cross-section of an involucral bract; letters as above; ×360.

Figure 14. Cross-section of an achenium; × 90.

Figure 15. Cross-section of part of an achenium, showing one of the crests; ×480.

a broad pith, hollow in the centre. Laticiferous ducts occur on the outer flank of the leptome, two to three in the larger, and one in the smaller strands. All the mestome-strands are of the collateral type, and the very short hadromatic rays contain only two to three spiral vessels, and a small strand of thin-walled parenchyma: endoxyle. The pith is homogeneous, thin-walled, and contains neither starch nor crystals.

The floral scapes of the secondary stage (July) are, as mentioned above, developed from the axils of leaves borne upon tall, ramified shoots (Fig. 1). They are obtusely hexangular, and very hairy from long, capitate hairs (Fig. 7). The cuticle, epidermis and cortex show the same structure as in the vernal scape, but the stele is here surrounded by a thin-walled endodermis, besides that a band of a few layers of stereome is located between the mestome-strands, though not of pericyclic origin. The laticiferous ducts show the same position as described above, on the outer flank of the leptome, but bordering here on the endodermis. There are 12 mestome-strands, six broad alternating with six thinner ones, and some of the thinnest (Fig. 11) may consist of leptome only, and with a single duct inside the endodermis.

The internodes of the branched shoot (Fig. 1) are hairy like the scapes, and cylindric, not furrowed. Their structure is almost identical with that of the scapes, but they lack hypodermal collenchyma, and the stele contains a circular band of 14 broad mestome-strands, all being of the collateral type. The endodermis is very distinct, and there is an interfascicular stereomatic tissue extending to the mestome-strands, and sometimes partly surrounding the hadrome of these.

According to Solereder the stem-structure of the *Compositae* is yet very imperfectly known, at least in a general way. The *Liguliflorae*, to which *Krigia* belongs, have been studied to some extent, however, on account of the frequent occurrence of bicollateral mestome-strands, which are not represented by *Krigia*. Very little is known about the structure of the cortex, and with regard to *Krigia* we have seen that this parenchyma is of the ordinary type in the scapes as well as in the internodes of the late, branching shoots.

There is no indication anywhere of a palisade-structure, although such might be expected in the late, branching shoots, of which the foliage is scantily represented in proportion to the length of the internodes and scapes, besides that all the basal leaves have withered, when the second blooming begins. The presence of an endodermis at the later stage, and its absence from the early is no unusual occurrence, for such may be observed in other plants, when we compare the apical internodes with the basal. We have failed to detect any pericycle in the stem of *Krigia,* although Solereder claims that the laticiferous ducts in the stem belong to this tissue. If such be actually the case, the pericycle would in *Krigia* be restricted to the mestome-strands, which would be contradictory in view of the name "peri-cycle." In the roots we have seen the ducts being located on the inner flank of the primary leptome, and later on covering the secondary leptome completely, thus bordering directly on the pericambium. Furthermore, when Solereder states that secondary latex-ducts may be observed in the secondary leptome of stems, as well as in the periphery of the medullary leptomatic strands of certain *Cichoriaceae,* the origin of these ducts does not seem to be in any connection with a pericycle. With special reference to *Krigia* the latex-tubes appear to belong to the leptome, which certainly is in agreement with the opinion of Westermaier, that they occur most frequently, but not exclusively, in the albumen-conducting tissues of the mestome-strands.

The leaf. In some of the earliest developed leaves of the rosette a petiole is quite distinctly represented. Examined at the "characteristic point" just beneath the leaf-blade the outline of the petiole is obtusely triangular. The cuticle is thin and smooth; the outer cell-wall of the epidermis is slightly thickened on the dorsal face and along the margins; hairs of the same structure as those of the stem are frequent along the margins. With exception of a small strand of collenchyma in the dorsal keel the cortex consists of a thin-walled parenchyma of roundish cells, containing chlorophyll, especially in the margins. There are three collateral mestome-strands, of which the median is the broadcast. They are surrounded by large-celled parenchyma-sheaths, contain-

ing very little chlorophyll, besides that an arch of thin-walled stereome covers the leptome in the central strand. The laticiferous tissue is represented by seven to eight ducts in the central strand, located between the parenchyma-sheath and the stereome; in the two lateral strands the latex-tubes, mostly two, are located between the leptome and the parenchyma-sheath. The central strand contains four short rays of spiral vessels, and no endoxyle is developed.

The leaf-blade shows a bifacial structure so far as concerns the chlorenchyma, but not with regard to the distribution of the stomata. Viewed in superficial sections the lateral cell-walls of the epidermis are slightly undulate on the dorsal face, but nearly straight on the ventral; the stomata are most abundant on the dorsal face, and are surrounded by four ordinary epidermis-cells. No hairs were observed. Viewed in transverse sections (Fig. 12) the epidermis is relatively large-celled, thin-walled and covered by a thin, smooth cuticle; the stomata are slightly sunk. The chlorenchyma consists of a single layer of typical palisade cells covering an open pneumatic tissue of three strata, of which the cells are slightly lobed, when viewed in superficial sections. The midrib shows the same structure as the central strand in the petiole, but has only two or three laticiferous ducts. A colorless parenchyma occupies the greater portion of the keel, while the pneumatic tissue extends uninterrupted above the mestome-strand. Characteristic of the leaf of *Krigia* is thus the development of stomata on both faces, and the poor equipment with mechanical tissues; the location of the latex ducts between the stereome and the parenchyma-sheath in the midrib of petiole and blade thus differs from what we have observed in the stem, where the ducts bordered directly on the leptome and the endodermis. But neither in the endodermis of the stem nor in the parenchyma-sheaths of the leaf was there any indication of cell-divisions resulting in the formation of ducts, as was observed in the roots.

The outer bracts of the involucre show a structure very different from that of the proper leaves, on account of the function which they perform. We remember that the *Liguliflorae* at the time of flowering open and close the heads in the morning and evening, besides that the involucral bracts

become reflexed, when the achnia have matured. The opening and closing of the heads are effected by the movement of the bracts; the liberation of the achenia is effected by the reflection of the bracts, their dispersal facilitated by means of their pappus. A cross-section of an involucral bract (Fig. 13) shows a thin-walled epidermis on both faces; there are stomata on both faces, and long, capitate hairs are frequent on the dorsal face (Fig. 7). A large, compact, thin-walled, colorless parenchyma of two strata is located inside the dorsal epidermis, the outermost consisting of very high cells resembling palisades; a similar colorless parenchyma, but of roundish cells with distinct intercellular spaces is located inside the ventral epidermis. Between these two hypodermal colorless tissues we notice a typical chlorenchyma of four to five strata, the cells roundish and containing some chlorophyll. This parenchyma is traversed by several mestome-strands, arranged in a single plane; they have no mechanical support, and the leptome is much better represented than the hadrome, many of the strands being even purely leptomatic, as shown in the figure (to the right of the larger strand); no laticiferous ducts were observed in the bracts.

The floral bracts show the same structure, with exception of the considerably greater width due to the extension of the epidermis on both faces, forming very broad, hyaline margins. This structure of the involucre with the large, dorsal, colorless parenchyma extends from the base of the bracts to a little above the middle, however, is not restricted to the bracts, but is continued to the base of the receptacle, thus surrounding the head completely. The schematic drawing (Fig. 3) shows a middle, as shown in the longitudinal section (Fig. 3). This tissue, however, is not restricted to the bracts, but is continued to the base of the receptacle, thus surrounding the head completely. The schematic drawing (Fig. 3) shows a head with young, immature achenia, and with the bracts still erect; at this stage the scale-like pappus as well as the bristles are erect. So soon as the achenia have matured, the bracts become strongly reflexed, and this movement is effected by the partial collapsing of the dorsal, colorless tissue at the base of the bracts. The movement of the bracts at sun-

set and sunrise depends upon the relative atmospheric moisture becoming absorbed by the cell-walls, thus causing a swelling of the cells, and consequently a closing of the involucre, while at sunrise the movement in the opposite direction is caused by a partial loss of the water imbibed. It is for the same reason that the bracts become reflexed, when the achenia have matured: they wither, losing the content of water completely. At this very moment the pappus opens, occupying a horizontal position, through the mechanical effect of the articulus, where the pappus is attached to the pericarp, and evidently caused by the same change of moisture condition.

The achenium is turbinate, of a dark, almost black color. A cross-section from the median part (Fig. 14) shows an approximately pentagonal outline with five prominent crests alternating with five pairs, lower and more obtuse. The epidermis (Ep. in fig. 15) is thick-walled and extended into erect, pointed papillae, especially along the crests. The mesocarp, drawn black in the figure (14) consists of many strata of sclereids; in the five prominent crests (Fig. 15) only the innermost strata of sclereids are very thick-walled and porous, the peripheral being relatively thin-walled, but the cell-walls of a deep brown color. In the lower crests the complete tissue is uniformly and very thick-walled. The endocarp (Fig. 15) is of a few strata of thin-walled parenchyma traversed by two very thin mestome-strands. A dark-colored, compressed and collapsed tissue represents the border of the central cavity, the caelum with the cotyledons.

The scales of the pappus (Figs. 4 and 5) consist only of epidermis, which on the upper face is extended into pointed papillae, but no mestome-strands are developed. The bristles are also papillose (Fig. 6), and destitute of mestome-strands.

SUMMARY.

In *Krigia Virginica* (L.) Willd. the involucre is represented by two whorls of bracts, of which the exterior are barren, the interior, on the other hand, subtending flowers. The shape and structure of the involucral bracts is identical with the only exception that the interior have broad hyaline margins. Both whorls perform the same function, facilitating the opening and closing of the capitulum, as well as facilitating the liberation of the achenia by becoming reflexed at the maturity of these. We see no reason why the interior bracts should not be termed involucral, even when they subtend flowers. If any such distinction should be drawn between these two whorls of bracts, there would be no involucre developed in species of *Adenostyles*, *Tagetes* and *Tragopogon*, where all these bracts are fertile. There are, of course, some cases where it is difficult to define the constituents of the capitulum with reference to the bracts, as, for instance, in *Xanthium* and *Ambrosia*. But in the majority of the *Compositae* the involucre is well differentiated; even where the interior whorl subtends flowers, these bracts show but seldom the same delicate structure as the paleae or chaff of the receptacle. We believe the term involucre is more significant, when not restricted to the barren bracts alone, and so long as the term involucral bracts, barren or fertile, does not convey the idea that they are morphologically distinct, this term ought to be retained.

Characteristic of *Krigia Virginica* are two well-marked stages of vegetation: a vernal and an aestival but with no modification of inflorescence or flowers. Of these the latter stage furnishes an illustration of the means by which an annual plant may persist for some months longer and bloom for a second time. This is effected by the development of a series of tall, branched shoots with many axillary scapes terminated by capitula, but with no subterranean structures, such as stolons, for instance.

As a member of *Liguliflorae*, *Krigia* has a system of articulated latex-tubes in root, stem and foliage. In the root these tubes appear at first on the inner flank of the proto-leptome (Fig. 8), extending from there to the pericambium, thus encircling the secondary leptome (Fig. 9). In the stem the latex-tubes are located between the leptome and the endodermis (Fig. 10). In the petiole and blade of the leaves of the rosette the latex-tubes follow the mestome-strands, and are located between the parenchyma-sheath and the stereome, that covers the leptome.

Besides these latex-tubes, *Krigia* has, furthermore, a system of endodermal ducts in the root (Figs. 8 and 9), which at first are noticeable by a tangential cell-division in endodermis, but only in a single cell

outside each of the primary leptome-strands; in older roots (Figs. 9) the whole endodermis shows cell-divisions resulting in the formation of a band of ducts corresponding with the oil-ducts in the roots of *Tubuliflorae*, but containing no oil. This very rare structure has also been observed in *Scorzonera*, *Scolymus* and *Tragopogon*, according to Van Tieghem. Conversely, latex-tubes have been found in the stem and leaf of *Gundelia*, a member of the *Tubuliflorae*, which lacks oil-ducts.

According to Solereder,* O. G. Petersen,** and several other authors, a number of *Liguliflorae* have leptome-strands in the pith of the stem, but these were not observed in *Krigia;* on the other hand, a more or less distinct endoxyle occurs in the aestival stage, but no internal leptome. Considering the fact that the aestival stage is so very scantily provided with foliage, we expected to find the cortex differentiated as a palisade-tissue, which is characteristic of similar more or less naked stems, but such was not the case with *Krigia.*

---

* Systematische Anatomie der Dicotyledonen. Stuttgart, 1899.

** Bicollaterale Karbundter. Thesis Kjoebenhavn, 1882.

Considered altogether, our *Krigia* possesses a complex of interesting structures, external as well as internal, which, if confined to *K. Virginica*, might be sufficient for considering the genus monotypic, as has been suggested by several systematists. It will, however, be necessary to study the other species in the same manner, and we hope some future investigator may be in the position to do so with more complete material accessible.

BOTANICAL GLEANINGS IN MICHIGAN.

III.

OLIVER ATKINS FARWELL.

The vernal season of 1925 opened some two or three weeks earlier than in the two preceding years and as the weather was warm and rain scarce, we got away to a flying start, so to speak, in field work. The early spring flowers, such as Spring Beauty, Purple Cress and Yellow Adder's-tongue, were out along the Ohio border by the middle of April, though not in the immediate vicinity of Detroit until a week later. The Wild Chervil is one of our rarer spring flowers; it has a specific name, *procumbens*, that is a misnomer as applied to our Michigan denizens. Here, the plants are erect or rarely decumbent, never procumbent. At the time of flowering, the Fringed Violet is one of our smallest and least conspicuous of violets. It is rather scarce, too, and liable to be overlooked as the plants are mostly single and widely scattered; occasionally they are larger, bunched and conspicuous but this condition is a rarity. It is found in sandy grounds.

It seems that our Common Blue Violet is very much of a cosmopolitan, adjusting and acclimatizing itself to any moisture degree and light; it is solitary or caespitose, then forming dense mats, and found in the shade of groves on alluvial lands whence it passes by degrees onto drier lands of banks and hillsides and into glaring sunlight; it makes its home with equal facility in the pure coal cinders of electric roads. The color of the rather large flowers is from deep violet-purple to pale violet-blue.

The Box Elder or Ash Maple is common in cultivation as a shade tree in our cities and villages; also, it is one of our native wild trees; but is much less frequent as such than as a cultivated tree. It inhabits the alluvial grounds near streams.

On May 6th we were overtaken by a snow-storm of short duration near Milan. Mostly the day was characterized by frequent showers of cold rain. We were rewarded by find-

ing Ginseng, not yet in flower, and *Trillium cernum* var. *declinatum* and its color forms, all in abundance. Milan is partly in Washtenaw County and partly in Monroe County. Our botanizing was in Monroe County. We observed some Cottonwood trees in excellent fruit but were unable to collect specimens as the trees were too large to shin up the trunk to where the fruit was. At Utica, *Trillium erectum* and *T. grandiflorum* were abundant. A few specimens of the white flowered variety of the former were found but not one of the variations of the latter was in evidence. The Black Poplar was observed along roadsides about two miles north of Utica. Other plants observed near Utica were the Dwarf Ginseng, the American Fly Honeysuckle, the Flowering Dogwood, the Small Yellow Lady's Slipper, the Bracted Green Orchis, and the dwarf Shadbush. At Inkster we found a small but interesting Beech woods that will soon be numbered with the everlasting past. Sidewalks of cement construction were already laid at regular intervals throughout. We observed some Sugar Maples whose bark had been punctured by a sap-sucker; the holes were about half filled with plugs of new bark.

The first ripe, Wild Strawberries were observed on May 27; on the same day the first Ox-eye Daisy and the first Yellow Pond Lily were seen in bloom. Also, on this day, I left my pocket knife at the foot of a *Crataegus succulenta* from which I had been cutting some specimens.

June 3rd was an extremely hot day but we were recompensed for this discomfort in a measure by finding a genus of plants, *Wolffia,* that we had never before seen in its natural habitat. It was associated with *Spirodela* and *Lemna trisulca.* In Commerce township, the most interesting find was *Matricaria suaveolens* called Pineapple Weed from a fancied resemblance of the odor to that of Pineapple. It seems to us to have the ill-scented odor of Dog Fennel. *Arenaria serpyllifolia* was common and in full bloom, the petals being not more than one-half the length of the sepals which is their usual size in this section of the country. *Cypripedium bulbosum* (*C. flavescens*) was in bloom but only two plants were seen. *Potentilla intermedia* was more or less plentiful. *P. Canadensis,* in rich woods, was *erect* about

eighteen inches high with no sign of a procumbent tendency; but after collecting and before pressing the tips had begun to curl. *Phlox pilosa* was frequent along the banks and some plants had very pale, almost white flowers. In Nankin township along the Venoy Road, we found June 10, what was left of an old residence, a stone-lined well, covered over, and the cellar with its stone walls; this latter was overgrown with trees and shrubs. The largest tree was a Poplar about twenty feet high with a diameter of 10.5 inches near the ground. In the cellar was a young *Catalpa cordifolia* J. St. Hil. (No. 7415b), about five feet high, the first instance I have seen of the self-seeding of this species. Nearby was a large specimen of the tree (No. 7415a), undoubtedly planted there when the one-time residence was occupied. Evidently one seed from this persistent tree found lodgment in the old cellar and the proper conditions for its germination.

At Algonac and vicinity on June 17, we found some interesting material. *Plantago Purshii* was gathered, this being our first acquaintance with it as a Michigan plant. Small, or dwarf specimens were only 11 lines high ending in a single flower. Associated with it was *P. Virginica*, the largest specimens of which were three inches high with leaves ten lines long and the smallest eleven lines high with two flowers. Also we found here *Viola Missouriensis* of the "Manual" in excellent summer stage. It is what Dr. Greene pointed out to me at one time as probably his *V. Dicksonii*. Very delicate forms of *Bromus secalinus* varied from two to eight inches in height and the inflorescences terminating the culms were reduced to a single spikelet.

Hieracium venosum was plentiful in copses. The leaves are variable in the amount of purple coloring matter which they show; some plants have the leaves nearly purple throughout and others vary in all stages to those that are green throughout.

The Yellow Sweet Clover, *Meliotus Meliotus-officinalis*, is frequent in southeastern Michigan but probably not in its typical form. Here the plant is never over two feet in height, usually much lower and with numerous short, ascending branches or none; flowers, 2 to 2.5 lines long. This form is probably the variety *confertus*. Another form most-

ly spreading on the ground with flowering racemes eight inches or so high, is probably the variety *arvensis*. The corollas of *Tradescantia reflexa* are red in some plants, blue in others. *Hordeum jubatum*, Squirrel Tail Grass, is sometimes a full yard in height. *Cirsum arvense* var. *integrifolium*, was observed in Maybee. *Persicaria villosula* is frequent at Flat Rock. A large stand of Lovage, *Levisticum Levisticum*, is near the west end of Mullet Lake. This was observed from the train window while on my vacation. Headquarters were at Lake Linden on Torch Lake, Houghton County. Several interesting things were found there.

On July 29, we made a trip to the lime pits near Maybee in search of *Sarothra* and *Xyris* but were unable to find them. The station evidently has been destroyed. In a previous paper, I mentioned a cut leaved *Silphium* at Sheldon guessed to be *S. laciniatum;* it was found in flower August 12, and the flowering plant proved our guess to have been correct; Mr. Gladewitz found it the same day at Eloise. Mention was made of *Sedum Fabaria*. Plants with subternate leaves when transplanted produced plants with opposite and alternate leaves respectively and the branches of the latter bore opposite leaves. Near Rochester, we found in fields the rare *Hieracium canadense* var. *macrophyllum*, on September 30. The leaves are much larger than in the species, less denticulate and of a different shape. Also dwarfed forms of Asters with one-flowered stems were numerous; these were of *A. azureus*, No. 7668, *A. laevis* var. *laevigatus*, No. 7669, (also at Ypsilanti, No. 7684, Oct. 14, '25), and of var. *amplifolius*, No. 7670. The latter was also found at Goodison, No. 7679 and at Goodrich No. 7674, September 23, *Gentiana crinita* was found at Geddes, No. 7694, only an inch and a quarter high, rather more than one-half of which was taken up by its single flower.

The last trip of the season was made October 14. The dam across the Huron R. at Geddes was destroyed or else the gates were wide open since the river was flowing within its natural banks and many acres of land that for many years have been four feet or more under water were again uncovered. An old wagon road and a lone buggy wheel were exposed, the former for several hundred yards. A number

of people were scattered along the length of the old road fishing in the shallow pools, an experience they will probably enjoy commenting upon for many years to come.

The reappearance of many unsuspected stumps and the blackened and decaying water vegetation gave an aspect of bleak desolation to a vast landscape.

Where the year of collection is not given, it is to be understood that Farwell and Gladewitz are the collectors and the year, 1925.

Botrychium dissectum Spring. Plentiful in a small woods near Disco. Nearly all plants had the preceding year's frond, now yellow and collapsed, still attached; only three or four plants had developed a fertile frond. A close scrutiny disclosed but a few specimens of the var. *elongatum* (Gilbert and Harberer) Farwell and none of these had produced a fertile frond. In this instance, the dissected form was about ten times as plentiful as the form with entire segments and was the only form to bear a fertile frond. Which is the mutant? Nos. 7527 and 7528 respectively, August 19.

Digitaria linearis (Linn) Pers. It seems probable that the Linnaean species was a mixture of two different plants, —the *Panicum Dactylon* and the *Panicum Ischaemum*. With the Bermuda Grass element removed, there is no obstacle to the continued use of the Linnaean name for the Crab Grass element. It has been collected near Ypsilanti by *Billington, Farwell,* and *Walpole* No. 5354, August 31, '19; *Farwell* and *Gladewitz* at Redford, No. 7245, October 8, '24; and at Oxford, No. 7618, September 2, '25; and by myself as follows:

Birmingham, No. 1576, September 9, '97; Belle Isle, No. 1576a, September 15, '97; Rochester, No. 4584, September 12, '17; Farmington Junction, No. 7632, September 9, '25.

Digitaria sanguinalis (Linn) Scop. Crab Grass. This is one of our commonest weeds. Often two feet in height with as many as 16 to 20 spikes arranged in several whorls or subwhorls, or scattered; the spikes are often six inches or more long. Belle Isle, No. 1267, July 21, '92; Ypsilanti, No. 1267a, June 27, '94; Detroit, No. 7634, September 10, '25.

Digitaria sanguinalis var. *repens* (Asch. & Grebn.) A variety that has shortened culms and spikes lying flat on the

ground; spikes 2 to 5 and about 2 inches long. Detroit, No. 7635, September 10, 1925.

Panicum Liebergii (Vasey) Scribn. Found on dry grounds at Ypsilanti. No. 7371, May 27, 1925, Sandy roadsides at Algonac, No. 7416, June 17.

Panicum clandestinum Linn. We collected this species in excellent flowering stage where we had it the preceding autumn after the fruits had fallen. Algonac, No. 7257, June 17. I collected it here in good fruit, No. 3889, September 13, 1914.

Phalaris Canariensis Linn. Hop Grass. The Canary Grass of the gardens. On the shores of Torch Lake, No. 7474, July 20, 1925. Detroit, on waste grounds. No. 1413, August 18, '93.

Alopecurus geniculatus Linn. Marsh Foxtail. In a moist depression associated with *Polygounm amphibuim* f. *terrestre* and f. *Hartwrightii* at Commerce. This is the first time I have seen the typical form of this species in Michigan. No. 7394, June 3.

Sporobolus neglectus Nash. Rush Grass. This species is quite frequent in southeastern Michigan. It has been collected at Detroit, No. 1681, September 24, '00; by *Farwell, Ford* and *Walpole* at Grosse Isle, No. 5989, August 31, '21; by *Farwell* and *Gladewitz* at Stony Creek, No. 6013, September 14, '21; at Rochester, No. 6866, October 17, '23; at Northville, No. 6458, October 18, '22 and at Goodison, No. 7677, September 30, 1925.

Sporobolus vaginaeflorus (Torr.) Wood. Rush Grass. In 1919, this species was common in the sand pits northwest of Rochester where it attained a very luxurious growth. It is no longer found in the pits but it is plentiful on the undisturbed adjacent grounds much reduced in size. No. 7661, September 30. *Farwell and Walpole* No. 5390, September 4, 1919. Clifton, No. 849 1-3, July 1, '95.

Eragrostis pectinacea (Mx.) Steud. This handsome species of grass was found in abundance at Royal Oak by *Billington and Farwell*, No. 5586, August 12, 1920.

Bromus secalinus Linn var. *Gladewitzii*, n. var. Chess. Slender, simple, up to 8 inches in height, leaves small, about an inch long, sparsely long hirsute above and ciliate, culm

terminated by a single, erect, ovate spikelet 7-lines or less in length, of 2 to 6 florets about 3 lines long, awnless. Edgewater Park, No. 7434, June 17.

Carex brunnescens (Pers.) Poir. A slender but stiff species allied to C. *canescens* but green instead of glaucous and with ultimately brown perigynia which have more distinct beaks. Eloise, No. 7408, June 10. Previously collected in Keweenaw Co., No. 625, July 26, '88 and No. 625a, Aug. 12, '88.

Carex brunnescens var. *sphaerosthachya* (Tuckerm.) *Kükenth.* (Var. *gracilior* Britt. and *C. canescens* var. *vulgaris* Bailey.) Amply distinct as a variety. It is more slender and weak, with spreading stems often prostrate, and has longer beaked, more spreading, *green* perigynia. Inkster, No. 7350, May 20. It has been previously collected in Keweenaw Co., No. 605, Sept. 12, '87, and at Port Huron, No. 4981, June 23, '18.

Carex Deweyana Schw., var. *stricta* Farwell. The culms in this variety are erect and but little longer than the leaves, some shorter. Near Utica, No. 7336, May 13.

Carex gracillima Schw., var. *humilis* Bailey. A low form with short, erect spikes. Inkster, No. 7344, May 20.

Carex tetanica Schk., var. *Woodii* (Dew.) Bailey. A very slender and lax, shady woods form of the species. Inkster, No. 7345, May 20.

Arisaema triphyllum (Linn) Schott, var. *viride* (Englr.) Farwell. Indian Turnip. A variation of the species with green spathes. Inkster, No. 7347, May 20. Several leaves were found with the lateral leaflets 2-divided.

Wolffia Columbiana Karst. Duckweed. On a small, probably artificial, and more or less stagnant lake in west Bloomfield township No. 7401, June 3.

Juncus effusus Linn, var. *compactus* Lejune and Courtois. At Eagle River, No. 7488, July 21, 1925; Clifton, No. 465a, August, 1900; Belle Isle, No. 465b, July 10, 1893.

Juncus Greenei Oakes and Tuckm. This looks something like *J. interior* but is darker green, coarser and rigid. In sand in Nankin, No. 7409, June 10. Previously collected in Keweenaw Co., No. 464, Aug. 30, '86; at Ypsilanti, No. 5274,

July 13, '19; Royal Oak, No. 5589, Aug. 19, '20; Monroe, No. 5909, July 6, '21.

Juncus Torreyi Coville, f. *longipes* Farwell. On the banks of the Rouge at Dearborn, No. 7515, Aug. 6.

Juncus alpinus Vill., var. *fuscescens* Fernald. In sand near Rochester, abundant; No. 7662, Sept. 30.

Unifolium bifolium (L.) Greene. Usually called Lily-of-the-Valley. The typical form with pubescent stem and leaves (on the under side) seems to be the prevailing form in southeastern Michigan. Commerce, No. 7390, June 3. Also, at Ypsilanti, No. 7381, May 27, 1925. The glabrous form, var. *Canadense* (Desf.) Farwell we found at Eloise, associated with *Viola latiuscula* and *Commandra Richardsoniana*. No. 7359, May 20.

Trillium erectum Linn. Bethroot. We found quite a little variation in this species. The peduncles, four inches or less in length, were mainly ascending or erect, but some were horizontal, and others reflexed, completing a range of half a circle. One rhizome with two stalks had one erect peduncle and one reflexed. Another with three stalks had peduncles erect, ascending, and horizontal. The largest leaf measured 6.25 inches across, the smallest 1.25. The largest pedal was .875 of an inch wide by 2 inches long, and the smallest .25 by .50. The stamens were shorter than the stigmas at the beginning of anthesis, increasing irregularly during the process, so that some were longer, some shorter, but all longer at the close of anthesis. The filaments were mostly very short, but some were nearly as long (.2 to .8) as the anther. In rich woods near Utica, Nos. 7327, 7328, 7329, and 7341, May 13.

Trillium erectum var. *album* (Mx.) Ph. This has white or cream colored petals and stamens, and a purple ovary. The filaments nearly as long as the anthers. Rich woods near Utica, No. 7332, May 13.

Trillium cernuum Linn, var. *declinatum* (A. Gr.) Farwell. In woods south of Milan. Peduncles from .25 to 1.5 inches in length, about one-third ascending, one-third horizontal, and the other third recurved, often crossing the stem beneath the leaves; the flowers of the horizontal peduncles were just below the leaves. No. 7315, May 6.

Trillium cernuum var. *declinatum* f. *Walpolei* Farwell. Peduncles .5 to 1.25 inches in length mainly recurved, and the purple flowers below the leaves. No. 7316, May 6.

Trillium cernum var. *declinatum* f. *Billingtonii* Farwell. Peduncles .75 to 1.875 inches in length, mainly recurved, and the brownish flowers below the leaves. No. 7317, May 6.

Sisyrinchium albidum Raf. The type locality according to E. P. Bicknell is West Kentucky where the species is always white flowered. This white flowered type I have seen for the first time in Michigan this year. It was in rather dry fields at Ypsilanti; No. 7368, May 27, 1925. The prevailing form of the species in Michigan has pale blue flowers and may be known as forma *coeruleum* n. f. Keweenaw Co., No. 461, Aug. 30, '86; Belle Isle, No. 461a, May 31, '93; Parkedale, No. 2699, June 11, '12.

Habenaria orbiculata (Pursh) Torr. Dinner Plate Orchis. In woods near Disco. Rare. No. 7524, Aug. 19. Previously collected near Farmington, No. 6142, May 23, '22; Copper Harbor, No. 3999, July 8, '15; Clifton, No. 3067, Aug. 22, '12. No. 358, collected at Clifton, Sept. 15, 1885, as this species, is *H. macrophylla* Goldie.

Corallorrhiza maculata Raf., var. *intermedia* Farwell. Frequent in dry woods at Oxford. No. 7605, Sept. 2

Salix longifolia Muhl. Sand Bar Willow. *Gray's New Manual* emphasizes the character of *two to three teeth to each cm. of margin;* the teeth are often as high as twelve to the cm. of margin at time of flowering. It is an unstable character and of no value. Eloise, No. 7363, May 20. Monroe, No. 7304, April 29, 1925.

Salix candida Flugge. Sage Willow. Frequent in bogs. *Farwell and Gladewitz* at Hamburg, No. 6769, Sept. 5, '23, and at Goodrich, No. 7650, Sept. 23, '25. I have it from Orion, No. 978, May 30, '95; Detroit No. 978a, July 24, '95; and Parkedale, No. 2557, May 19, '12.

Populus canescens Sm. White Poplar. This is plentiful near Goodrich where it has become naturalized as an escape from cultivation. No. 7640, Sept. 23.

Populus nigra Linn, var. *Betulifolia* (Ph.) Torr. Black Poplar. Evidently these trees have been planted along roadsides as shade trees. Three or four near a dwelling and an

equal number a half mile away along a roadside fence row. Young trees in the immediate vicinity indicate suckering. The outer bud scales are dry but the inner scales and young growths are viscid aromatic or balsamic; the leaves are pubescent throughout; the blades are rhombic-triangular, broadly cuneate at base, long acuminate at apex and longer than broad. The capsules are ovoid, acute, on pedicles about one half their length. About 2 miles north of Utica, No. 7340, May 13.

Myrica Gale Linn. The Sweet Gale is a native of swamp regions. We have two varieties in Michigan; the typical variety has the leaves pubescent underneath. Keweenaw Co.; Clifton, No. 29, July 10, 1883; Copper Harbor, No. 1615½, Aug. 24, '98; Phoenix, No. 1833½, August '04.

Myrica Gale var. *subglabra* (Chevalier) Fernald. This variety has the leaves glabrous underneath. As yet, we have observed it at only one place, the swampy borders of Cass Lake in Oakland Co., where it was first detected by Mr. Billington of Detroit, in 1916. No. 4255, June 29, '16; *Chandler and Farwell*, No. 5229, June 5, '19; *Farwell and Gladewitz*, No. 7223½, Oct. 1, 1924.

Alnus incana (Linn) Moench. The Common Alder of Michigan. Leaves glaucous underneath. Swamps near Eloise No. 7357, May 20.

Alnus incana var. *Americana* Regel. Alder. Along the borders of streams. Leaves green underneath and more densely pubescent, some more or less obovate. Rarely seen in the southeastern part of Michigan. Near Utica, No. 7325, May 13.

Rumex Mexicanus Meisn. Shores of Torch Lake, No. 7467, July 20, 1925; Rochester, No. 229b, June 30, '09; Keweenaw Co., No. 229, June 20, '85; Pontiac No. 5269, June 29, '19; Detroit, *Billington and Farwell*, No. 5092 July 14, '18.

Polygonum Fowleri Robinson. Has the prostrate habit of *P. littorale* but has longer, narrower, different colored leaves, rose sepals and exserted achenes. Sand banks, shores of Torch Lake, No. 7476, July 20, 1925.

Polygonum amphibium var. *natans* f. *emersum* (Mx) Farwell. This plant was collected at Dearborn in a hollow containing water early in the season, but which was dry

later. The early plants had the usual aquatic leaf-form, i. e., smooth, cordate-ovate leaves on the lower part of the stems, the others being of the terrestial form. No. 7403, June 10.

Chenopodium Boscianum Moq. At Flat Rock. Scarce. No. 7496, July 29. Not listed in the "Mich. Flora."

Chenopodium Botrys Linn. Jerusalem Oak. Frequent along the shores of Torch Lake, No. 7468, July 20, 1925; Keweenaw Co., No. 1477a, June 27, '95; Detroit, No. 1477, Aug. 13, '94.

Corispermum Hyssopifolium Linn. Bugseed. This plant is now abundant in the sand pits northwest of Rochester. In 1919 it was scarce and the plants were small and simple. It now rivals the Russian Thistle in size, habit and abundance. No. 7671, Sept. 30. *Farwell and Walpole* collected it here, No. 5389, Sept. 4, 1919. I collected it at Detroit, No. 1690, Oct. 2, '00.

Allionia Gladewitzii Farwell. Excellent specimens of this were found at Sheldon, No. 7509, Aug. 12, 1925.

Dianthus Armeria Linn. Depford Pink. Roadsides near Algonac, No. 7417, June 17; Maybee, No. 7439, June 24: we collected it near Monroe, No. 5833, June 9, 1921, and at Metamora, No. 6651, July 18, 1723. Collected previously by myself at Detroit, No. 1672, June 16, 1900, and at Royal Oak, No. 5588, Aug. 12, '20. Usually it is found in sandy grounds along roadsides, but may be found also in grassy grounds and in open woods.

Dianthus deltoides Linn. Maiden Pink. At Clifton it is quite frequent over a stretch of half a mile. No. 7484, July 21, 1795; No. 3061, Aug. 22, '12; and No. 2196, Oct. 5, '10.

Dianthus barbatus Linn. Sweet William. At Eagle River, as an escape, No. 7487, July 21, 1925; Clifton, No. 284, July 26, '85; Belle Isle, No. 284a, June 22, '94; Algonac, No. 3208, Oct. 13, '13.

Portulaca oleracea Linn, var. *sativa* (Haw.) Dc. (*P. neglecta* Mackenzie and Bush). Very fleshy, leaves often two inches long by two thirds as wide at the refuse or emarginate apex, stamens 16, stems ascending or becoming prostrate. Dearborn, No. 7511, and Eloise, No. 7518, Aug. 5th.

Ranunculus Delphinifolius Torr. This species was found

in a stagnant pool along the Grand Trunk Western road in West Bloomfield in both flowering and fruiting condition. No. 7395, June 3. Previously collected at Detroit, No. 1892, May 27, '05; Washington, No. 4154, May 25, '16; Cass Lake, No. 4250, June 29, '16; La Salle, No. 5755, May 19, '21. A very small, pubescent form, creeping on muddy grounds is var. *terrestris* (A. Gr.) Farwell. Dearborn, No. 7402, June 10. Previously collected on Belle Isle, No. 1366, June 15, '93; Rochester, No. 4576, June 12, '17; Utica, No. 6307, Aug. 2, '22.

Syndesmon Thalictroides (L.) Hoffmg. Rue Anemone. The typical form of the species with the involucre composed apparently of a number of simple, petioled leaves. The first time I have seen it in Michigan. Commerce, No. 7383, June 3.

Hydrastis Canadensis Linn. Golden Seal. In woods at Commerce. From one to two score plants are here. The flowering season had passed. No. 7386, June 3.

Asimina triloba (Linn) Dun. Papaw. A large grove of this species covers the banks of the River Rouge near Dearborn. At this time of the year the young fruits were from one to two inches in length. No. 7513, Aug. 6. It was collected here July 8, 1917, No. 4515b. Also, at Detroit, No. 4470, June 2, 1917.

Papaver Rhoeas Linn. Corn Poppy. An escape along the shores of Torch Lake, No. 7466, July 20, 1925. Detroit, in waste grounds, No. 2876, July 18, '12.

Argemone intermedia Sweet. Prickly Poppy. This was found at Flat Rock. Probably an escape from cultivation. No. 7463, found at Flat Rock. Probably an escape from cultivation. No. 7463, July 1.

Brassica Napus Linn. Rape, Cole. Very much like *B. campestris* but entirely glabrous, larger and fleshier, the woody tap root is larger, about as large as the finger. Waste grounds at Dearborn, No. 7505, Aug. 5. The var. *Napo-Brassica* (L.) Reichb. was observed along railroad banks at Sheldon, Aug. 12, 1925. In this the long conical tap root was not woody nor larger at the top than an inch in diameter, and all the leaves were glabrous, glaucous, and run-

cinate pinnatified. As it was not in flower, no specimens were collected.

Brassica compestris Linn. Field Cabbage. Glaucous and more or less hispidulous on the lower parts. Leaves cordate clasping, lowermost runcinate. Collected at Lake Linden, No. 7470, July 20, 1925; Keweenaw Co., No. 160, Aug. 10, 1884; Ypsilanti, No. 160a, June 18, 1892; Detroit, No. 160b, July 15, 1893. Frequent in waste grounds throughout the state.

Hirschfeldia Gallica (Wild.) Farwell. In waste grounds at Flat Rock, No. 7461, July 1.

Conringia orientalis (L.) Dum. Hare's-ear Mustard. A luxuriant form. Flat Rock, No. 7462, July 1. Also in Keweenaw Co., No. 837, Aug. '94; Dearborn, No. 4516, July 8, '17; Rochester, No. 4506, June 28, '17.

Radicula sylvestris (Linn) Druce. On roadsides and in waste grounds at Flat Rock. Nos. 7453 and 7454, July 1.

Barbarea verna (Mill.) Asch. Scurvy Grass. Rarely seen and only in small amounts. Eloise, No. 7352, May 20.

Dentaria diphylla Mx. Pepperroot. The stem of this species has two leaves opposite or nearly so, usually three-foliolate. At Milan we found a large stand of it in full bloom. The stem leaves, however, varied from simple and toothed through all stages of subdivision to 3-foliolate, some of them even being bilobed. No. 7309, May 6.

Arabis laevigata (Muhl.) Poir., var. *heterophylla* (Nutt.) Farwell. This var. has the lower part of the plant and the rosette leaves spreading pubescent. Roadsides in Nankin, No. 7405, June 10.

Sedum Telephium Linn, var. *purpureum* Linn. [*S. triphyllum* (Haw.) S. F. Gray; *S. Fabaria* Koch, (1837); *S. purpurascens* Koch, (1843)]. Orpine; Liveforever. This plant is well scattered over Michigan. The leaves vary from ovate to broadly ovate, the uppermost being rounded at base and sessile, while the lowermost are narrowed into a short petiole; on some plants, the leaves are dense and subternate, longest at the middle of the stem, thence gradually reducing each way, the stem ending in a strictly terminal, dense, leafless compound cyme; others have the leaves more separated, of about the same length throughout, opposite or alternate,

the stem ending in a loose, leafy-bracted, compound cyme of both terminal and axillary elements. Denton, Nos. 7518 and 7517, August 12, 1925. Previously reported as var. *Fabaria* (Koch) Steud.

Ribes triste Pall., var. *albinervium* (Mx.) Fernald. This is our native Red Currant, found in rich woods and along the banks of streams, etc. Near Utica, No. 7334, May 13. It has been collected before in Keweenaw Co., No. 20, June 18, '83. At Oxford, No. 5221, May 27, '19; and at Bloomfield, No. 4429, May 13, '17.

Ribes odoratum, Wendl. Buffalo Currant. Cultivated. Also along a roadside fence row where the indications were that it was an escape from cultivation. Near Utica, No. 7321, May 13. It has been collected before in similar situations, at Ypsilanti, No. 1104, April 20, '91; Dead Lake, No. 1104a, July 16, '09; Rochester, No. 2568, May 19, '12; Orion, No. 6907, June 4, '24. We also found this as an escape and intermixed with the dwarf *Shadbush* on the Disco Road, No. 7597, Aug. 26.

Geum Canadense Jacq., var. *camporum* (Rydb.) Fernald & Weath. The plant previously reported as var. *flavum* (Porter) Britt. belongs here. The petals were pale yellow, but probably this color was the result of fading. This variety was collected near Disco, No. 7525, Aug. 19.

Geum Virginianum Linn. Rough Avens. Very common. Dearborn, No. 7404, June 10, '25. We have collected it at La Salle, No. 6293, July 26, '22, and at Monroe, No. 6706, Aug. 22, '23. I have collected it at Ypsilanti, No. 5250a, June 15, '19, at Mt. Clemens, No. 6377, Aug. 25, '22, at Parkedale, No. 2761, June 30, '12, and on Belle Isle, No. 1401, July 21, '93.

Geum Virginianum var. *Murrayanum* Fernald. This is a variation with perfectly glabrous fruit. I have found it only at Erie, No. 6640, July 11, 1923. The plant previously reported as this variety is the typical form of the species, setose on the back, at the top of the fruit and around the base of the style.

Geum macrophyllum Willd. Very rare. Near Disco, No. 7526, Aug. 19.

Rubus neglectus Peck. Plant similar to *R. occidentalis*

but with the prickles of *R. strigosus*. Dearborn, No. 7507, August 5.

Rosa Damascena Mill. The Damask Rose. Near the cellar remains of an old residence at Nankin. Probably once cultivated but now persistent; perhaps 15 years since it received cultivational care. The stem is green, a foot or so high, entirely smooth; the 7-9 leaflets are simply serrate and more or less pubescent beneath; the pedices and hip are glandular and the three outer sepals are pinnatifid. No. 7415, June 10. With it was *Rosa blanda* Ait., No. 7414.

Rosa Virginiana Mill. var. *vulgaris* (Crepin) n. comb. (*R. parviflora* var. *vulgaris* Crepin) sub. var. *villosa* (Best) [*R. humilis* var. *villosa* Best in Bull. Tor. Club XIV (1887) 256. *R. Lyoni* Pursh. Fl. Amer. Sept. (1814) 345]. Leaves pubescent underneath. Banks and dry grounds at Geddes, No. 7691, Oct. 14, 1925.

Rosa Virginiana Mill., var. *glandulosa* (Crepin) Farwell. Associated with the above. No. 7690.

C. Crus-galli Linn, var. *Prunifolia* (Marsh.) Loudon. (*C. Farwellii* Sargt.) Corymbs pubescent, leaves broadly obovate. On exposed hilltops near Oxford; the first time I have seen it in another place than on Belle Isle. No. 7614, Sept. 2.

Crataegus Grayana Eggelston. A peculiar species having the points of many of the leaf-lobes recurved. Farmington, No. 7622, Sept. 9, '25.

Crataegus Alnorum Sarg. Some of the leaves are broader than long and all the fruit examined had but two nutlets each. Near Goodrich, No. 7637, Sept. 23.

Crataegus filipes Ashe. (*C. opulens* Sargt.) On hillsides at Rochester. Some of the leaves are very deeply threelobed. No. 7664, Sept. 30. Previously collected at Parkdale, No. 3270, Oct. 27, '12.

Crataegus Acerifolia Moench. The flowers of this species have a very unpleasant odor. Near Milan, No. 7308, May 6.

Crataegus macracantha Lodd., var. *succulenta* (Schrad.) Eggelst. Flowers May 27, and fruit Oct. 14, 1925. Ypsilanti, No. 7367. The knife dropped here when the flowers were collected was not in evidence when the fruit was gathered.

Pyrus Prunifolia Willd. Crab Apple. A tree about 20 ft.

high with an equal spread of branches; leaves from 1 to 4 inches long, obovate, oval, suborbicular or ovate, glabrous or with a trace of pubescence at the base of the blade on the under side, on glabrous or pubescent petioles up to 1.5 inches long; yellow fruit, globular or ovoid, .75 to 1.25 inches with persistant calyx and cavity at base on glabrous or pubescent peduncles about .75 inch long. A roadside tree and apparently an escape, as there are no orchards anywhere near. On the Disco Road, No. 7598, July 26.

Lupinus perennis Linn, f. *albiracemus* A. H. Moore. This white flowered form was again collected, this time at West Bloomfield; No. 7396, June 3.

Melilotus Melilotus-officinalis (L.) Asch. & Graebn., var. *confertus* (O. E. Schulz) Asch. & Graebn. Dearborn, No. 7506, Aug. 5. Nankin, No. 7517, Aug. 5.

Melilotus Melilotus-officinalis (L.) Asch. & Graebn., var. *arvensis* (O. E. Schulz) Asch. & Graebn. Sheldon, No. 7513, Aug. 12, 1925.

Trifolium procumbens Linn. Small Hop Clover. Not as widely distributed as the *T. agrarium* nor as frequent. Rochester, No. 2196, July 24, '10; River Rouge, No. 5140, Sept. 15, '18; Ypsilanti, No. 5745, May 15, '21; Farmington, No. 7624, Sept. 9, '25.

Robinia Pseudo-Acacia Linn. Black Locust. At West Bloomfield in a situation where the probabilities are against its being a cultivated plant. Either native or naturalized. No. 7400, June 3.

Meibomia rotundifolia (Mx.) OK. Tick Trefoil. In dry hardwoods. Rare. Oxford, No. 7613, Sept. 9. It has been collected at Orion, No. 918, Aug. 29, '95, and at Royal Oak, No. 5589c. Aug. 12, '20.

Lespedeza violacea (L.) Pers. Bush Clover. This Species, rare in Michigan so far as my experience goes, was found at Geddes in good fruit. No. 7692, Oct. 14, 1925.

Pisum sativum Linn. The Garden Pea. It was found in wild or uncultivated fields near Rochester, No. 7659, Sept. 30.

Lathyrus palustris Linn., var. *linearifolius* Ser. In fields near Algonac. No. 7432, June 17.

Lathyrus venosus Muhl., var. *intonsus* Butters and St. John. Said to be infrequent but found throughout the State;

the buds are white and the flowers bluish-purple and white. Banks and hillsides in more or less shade. West Bloomfield, No. 7398, June 3. A form with the buds and upper part of the calices a bright rose red and with rose-purple flowers may be known as forma *roseus* n. f. West Bloomfield, No. 7399, June 3.

Oxalis corniculata Linn., var. *Dillenii* (Jacq.) Trelease. [*Oxalis Dillenii* Jacq., Oxal. (1794) 28; *Oxys lutea Americana* etc. Dill. Hort Elth. (1732) 298 t. 221, f. 288; *O. stricta* Linn Sp. Pl. (1853) I 435 as to the Gronovian synonym; *O. corniculata* var. B. Linn. Sp. Pl. (1762) I 623.] Under the Vienna Rules Article 46, when an author unites two or more species of the same date, he chooses the name and that choice cannot be modified by subsequent authors. Presumably, this rule holds true for the reverse action, i. e., when a species is divided, the author leaves the name for that part of the aggregate which, judging by its name or description, is the origin of the species; if there is no such indication, the author chooses and his choice cannot be modified. In the case of *Oxalis stricta* Linn, there are three synonyms cited; but *no description that is original* with the Species Plantarum. There is nothing in one synonym over the others to indicate which one gave rise to the specific name *stricta*. As *O. stricta* is an aggregate, the author first dividing it, chooses that part to which the name *stricta* belongs, and that choice cannot be modified. When Jacquin published his *O. Dillenii* in 1794, based upon figure 288 of Dillenius, the Gronovian synonym which is conceded by all to be identical, automatically was removed from *O. stricta*, leaving that name for the synonym of Morison. Furthermore, Linnaeus, himself, placed the Dillenian species, identical with the Gronovian, as var. *B.* under his *O. corniculata* which action indicates that he probably considered the Morison synonym as representative of his *O. stricta*. Therefore, *O. stricta* under the Vienna Rules interpreted as above, is the proper name for the cymosely-flowered plant recently described as *O. cymosa* by Small, and more remotely as *O. Europoea* by Jordan.

Now, if we look at the American Code, we find that Canon 14 (c) provides that in default of an originally cited speci-

men as the type, the first cited identifiable figure is to be considered as the specific type of the species. Therefore, the Morison citation, with an identifiable figure, must be considered as the type of *O. stricta* Linn. According to Dr. B. L. Robinson, this figure is clearly the cymose-flowered species called *O. cymosa* by Small. Thus, by both the systems of nomenclatorial rules used in this country, the common cymose-flowered, yellow *Oxalis* is the type of *O. stricta* Linn.

In referring to the Vienna rules above, I purposely used the word presumably, for the rules are silent about the points involved. The next International Congress might remedy their rules regarding the conservation of the specific name, when an aggregate is divided, so I suggest the following as supplemental:

(a) The specific name shall be retained for that part of the species which gave rise to it if that is determinable.

(b) When it cannot be determined what part of the aggregate gave rise to the specific name, the latter shall go with the oldest synonym that carries an identifiable figure, if there is such.

(c) When neither *a* nor *b* applies, the identifiable synonym that is oldest in point of pubilcation shall be considered the type to which the specific name shall apply. The above refer particularly to the publication of species based upon citations and without original descriptions, as in the case of *Oxalis stricta* Linn. I have collected this variety as follows: Royal Oak No. 4557, Sept. 8, '17; Dearborn, No. 4660, Sept. 29, '17. The form without villous hairs on the capsules may be known as subvariety *piletocarpa* (Wieg.) n. comb. *O. stricta* var. *piletocarpa* Wieg. in Rhodora XXVII (1925) 123. I have collected it at Rochester, No. 1524, July 4, '96, and No. 4502 1-3, June 17, '17; Belle Isle, No. 1524a, June 14, '01; Dearborn, No. 4530 1-2, July 14, '17; Oxford, No. 6413, Oct. 4, '22 and No. 7617, Sept. 2, '25; Farmington Junction, No. 7631, Sept. 9, '25; Parkedale, No. 2671, June 11, '12; Algonac No. 2712, June 16, '12.

Euphorbia dentata Mx., var. *lancifolia* Farwell. This is the narrow leaved form of the species and was found on railway banks at Oxford; No. 7602, Sept. 2.

Negundo Fraxinifolium (Nutt.) n. comb. *Acer Fraxinifolium* Nutt. Gen. I (1818) 253; *Rulac Nuttallii* Nieuwl. in Amer. Mid. Nat. II (1911) 137; *Negundo Nuttallii* Rydb. in Bull. Tor. Bot. Club XL (1913) 55; *Acer Negundo* var. *violacem* Kirchner. Box Elder. This species differs from *N. Negundo* in its glabrous fruits in its glaucous-blue branchlets and petioles. Keweenaw Co., No. 803, Aug. 21, 1890. Ypsilanti, No. 803a, May 12, 1891, and May 27, 1925; Detroit, No. 803b, June 21, 1901; Stony Creek, No. 3341, May 4, 1913; banks of the Raisin River at Monroe, No. 7305, April 29, 1925, and Maybee, No. 7445, June 24, where it is planted as a shade tree along the roads; Calumet, No. 7491, July 21, 1925. This species is in general cultivation in Michigan. The seed germinates readily and young trees from self sown seed are found in abundance. Young fruits are more or less glaucous, also.

Vitis aestivalis Mx. Fence rows along roadsides at Oxford. Evidently a cultivated grape that has escaped. No. 6674, August 18, 1923; fruit, September 2, 1925.

Malva moschata Linn. Musk Mallow. In the typical form the root leaves are reniform and coarsely, palmately toothed or parted and the uppermost stem leaves are palmately divided with the divisions toothed; the flowers are pale rose or pink. It has been collected at Oxford, No. 5617, August 22, 1920; at Shelbyville, No. 6572a, June 21, 1923; at Almont, No. 6271g, July 19, '22; at Amy, No. 6965, July 9, 1924.

Malva moschata var. *undulata* Sims. In this variety the root-leaves are orbicular with a crenate margin and the upper stem leaves are palmately divided, the divisions being once or twice pinnatifid; the flowers are white. It has been collected at Junior, No. 5077, July 13, '18; at Lake Linden, No. 5965, August 10, '21, and No. 7475, July 20, '25; at Shelbyville, No. 6572b, June 21, '23.

Viola nephrophylla Greene. Rich woodlands near Milan, No. 7318, May 6. This is associated with *V. communis* but it is scarce while that is abundant. The oblong and obtuse sepals and the bearded spur petal distinguishes it. Also at Inkster in similar situations, No. 7343, May 20.

Viola latiuscula Greene. Sandy grounds in dry woods

near Eloise. The purplish color on the under side of the leaves had nearly disappeared at this time of the year. No. 7358, May 20.

Viola domestica Bickn., var. *communis* (Pollard) Farwell. Our commonest violet. Monroe, No. 7300, April 29, '25; in rich woodlands near Milan, No. 7319, May 6. Forma *alba* (T. and Gr.) Farwell was found near Milan, No. 7310, May 6 and Utica, No. 7339, May 13. The flowers of No. 7339 were pure white except for the veins and the spur while those of No. 7310 had more color, the base of all the petals being of a pale violet blue.

Viola Dicksonii Greene. A near relative of *V. cuspidata.* In woods at Inkster, No. 7346, May 20 and at Algonac, No. 7427, June 17. *V. Missouriensis* Greene?

Viola fimbriatula Sm. The larger plants simulate very closely the Arrow Violet, especially during the summer, when the leaves have elongated petioles, much longer than the blades. Near Monroe, No. 7307, April 29, '25. At Eloise, on sandy hills, we found typically pure *V. fimbriatula* with rather broad, glossy leaves, which had no petioles longer than the blade. No. 7362, May 20. Mr. Gladewitz found it here twelve years ago, when it was more plentiful than now.

Viola lanceolata Linn. On moist grounds covered with Steeple Bush and other low shrubs near Eloise where it is now abundant though when Mr. Gladewitz discovered this station some twelve years ago there was scarcely a dozen plants at that time. No. 7354, May 20.

Dirca palustris Linn. Leatherwood. In rich woods near Utica, No. 7335, May 13. It has been collected before in Keweenaw County, No. 231, June 20, '85; at Redford, No. 4421 1-2, April 29, '17.

Epilobium adenocaulon Haussk., var. *perplexans* Trelease. Has flaccid leaves. Cedar swamps near Oxford, No. 7606, September 2.

Oenothera laciniata Linn. In yellow sand at Algonac, June 17. It was collected here by *Billington, Walpole and Farwell,* No. 5500, June 20, 1920, and by me at Detroit No. 1468, July 5, 1894.

Oenothera perennis Linn. In open, low grounds near Eloise. The stems are grayish with appressed pubescence

rather than *puberulent* as the manual has it. Mr. Gladewitz discovered it at this station, some twelve years ago. No. 7407, June 10. Previously collected in Keweenaw County, No. 855, July 5, '95.

Panax quinquefolium Linn. Ginseng. Some seven or eight plants were observed; the flower buds were well developed. Milan, No. 7320, May 6.

Chaerophyllum procumbens (Linn) Crantz. This is found on alluvial grounds. South Rockford, No. 4151, May 21, 1916; Redford, No. 4857, May 24, 1918; Monroe, No. 7299; April 29, 1925. These stations are in the valleys of the Huron, Rouge and Raisin rivers respectively.

Uraspermum dulce (Muhl.) Farwell, var. *laevicaule* Farwell. A new station for this nearly glabrous variety was found in woods at Inkster, No. 7348, May 20.

Uraspermum aristatum (Thnb.) O.K., var. *villicaule* (Fernald) Farwell. A new station for this villous variety was discovered at Ypsilanti, close to a fence in the outlying district towards Geddes. No. 7370, May 27, 1925.

Levisticum Levisticum (Linn) Karst. Lovage. Lake Linden, No. 7477 1-2, July 20, 1925. It was collected here, No. 1615a, August 25, '98.

Aegopodium Podagraria Linn, var. *variegatum* Bailey. Goutweed. Common in cultivation and as an escape at Marine City. On the banks of the Bell river. *Farwell and Gladewitz*, No. 6732 1-2, August 29, '23.

Monotropa Hypopithys Linn. The European type is not found in this country; it is glabrous except for the inner surface of the petals, stamens, ovary, style and stigma, which are pubescent, the latter with a retrorse beard. Its American representative has been describd as *M. lanuginosa*, but it is scarcly of specific distinction; it is somewhat smaller, is more or less crimson or yellowish, and pubescent throughout. It may be known as var. *rubra* (Torr.) n. comb. [*M. lanuginosa* Mx. var. *rubra* Torr. in *Flora N. Y.* I (1843) 457 and Pl. 72.] Another variation has less pubescence, is more often yellow or pinkish, and the stigma is without a retrorse beard. It may be known as var. *Americana* (D. C.) n. comb. [*Hypopithys Europaea* Nutt. Genera I (1818) 271; *H. multiflora* var. *Americana* D. C. in Prodr. VII pt. 2

(1839) 780; *M. lanuginosa* var. *glabriuscula* Torr., l. c.] The part of the stem, often one half of it, below the surface, is ivory white, as in *M. uniflora*. Dry woods near Oxford; No. 7612, Sept. 2. Michigan is within the range given for each of these varieties, but I have detected only this one. Also Keweenaw Co., No. 331, Aug. 16, 1885. This species is the type of the subgenus *Hypopithys* Torr. l. c. usually accredited to A. Gr. of a later date. The var. *Americana* is recognized by some authors as a good species under the name *Hypopithys Americana* (D. C.) Small. But Nuttall's name, unquestionably applied to this plant and valid for it, is much older, yet perhaps not the oldest given it. Rafinesque published in 1810 four or five species of *Hypopithis*, one of which might apply to it.

Samolus floribunda HBK. Water Pimpernel. Borders of depressions containing water. Near Dearborn, No. 7514, Aug. 6.

Gentiana flavida A. Gr. This species is rather plentiful on high, dry grounds at Superior, No. 7688, Oct. 14, '25.

Apocynum pubescens R. Br. Indian Hemp. The calyx lobes and pedicels are pubescent and the leaves are rather densely white pubescent beneath. The first time observed in Michigan, though another species many years ago was collected for it. On roadsides and banks, Maybee, No. 7438, June 24; Flat Rock, No. 7451, July 1.

Ipomoea purpurea (Linn) Roth. Morning Glory. This was found in fields near Rochester as an escape from cultivation, probably. No. 7660, Sept. 30. In similar situations at Goodison, Sept. 30.

Ipomoea pandurata (L.) G. F. W. Mey. Manroot. This is an extensive vine with coarse stems either twining or trailing, often many yards in length. The root is used in medicine to some extent. Raisinville, No. 7500, July 29.

Verbena stricta Vent. Hoary Vervain. This is one of our less frequent species of vervains. Generally found in dry grounds, such as hillsides, etc. Nankin, No. 7516, Aug. 5. Previously at Pontiac, No. 6359, Aug. 16, '22, and on Belle Isle, No. 1766, Sept. 28, '01.

Moldavica parviflora (Nutt.) Britt. Dragonhead. This

was found in sandy grounds at Flat Rock, the first time met with in Michigan, No. 7493, July 29.

Moldavica Moldavica (L.) Britt. Dragonhead. This species was collected in Keweenaw Co., No. 1827, August, '04. Previously but wrongly reported as the preceding species.

Lamium amplexicaule Linn. Dead Nettle. At Commerce, this species was quite plentiful in ground that had once been cultivated. No. 7387, June 34.

Salvia officinalis Linn, var. *tenuior* Alef. Domestic Sage. Cultivated in America for commercial purposes. An escape at Nankin. No. 7410, June 10. Previously collected at Island Lake, No. 1924, July 16, '05.

Physalis grandiflora Hook. Ground Cherry. In clearings, fields, and old gardens. Scarce. Phoenix, No. 286, Aug. 1, '85.

Physalis Philadelphica Lam. (*P. subglabrata* Mackenzie and Bush.) In fields and rather frequent. On Belle Isle, No. 1554, Sept. 10, '96; Monroe Piers, No. 5567, Aug. 8, '20; La Salle, No. 6280d, July 26, '22; Ypsilanti, No. 6331, Aug. 9, '22; Farmington, Nos. 7625 and 7628, Sept. 9, '25.

Physalis Virginiana Mill. The typical form with long soft hairs. Near Disco. No. 7591, Aug. 26. I have collected it at Clifton, No. 285, July 26, '85, and at Island Lake, No. 285a, July 16, '05.

Physalis Virginiana var. *vulgaris* Rydb. The more common form with less pubescence of short recurved hairs. Near Disco, No. 7595 1-2, Aug. 26. This was collected here by *Brotherton and Farwell*, No. 285b, July 24, '10. We have collected it also at Trenton, No. 5932, July 26, '21, and at Monroe, No. 6710, Aug. 22, '23.

Physalis Virginiana f. *sanguinea* Farwell. This has a red striped stem and red veins. Belle Isle, No. 1428, Aug. 30, '93, and Trenton, No. 5932a, July 26, '21.

Physalis lanceolata Mx. Detroit, No. 3980, June 19, '15.

Physalis heterophylla Nees. Perhaps our commonest species of ground cherry. Disco Road, No. 7594 and Stony Creek, No. 7599, August 26. Previously at Detroit No. 1377, June 22, '93; Orion, No. 1377a, August 29, '95; Parkedale, No. 1377b, June 23, '09; Rochester, No. 2951, July 28, '12.

Physalis heterophylla var. *ambigua* (A Gr.) Rydb. More

abundant than the specific type. Stony Creek, No. 7601, Aug. 26. Previously at Clifton, No. 623, July 26, '88; on Belle Isle, No. 623a, September 10, '96; Parkedale, No. 623b, June 30, '09; River Rouge, No. 4117, Sept. 30, '15; Goodison, No. 6384, Sept. 4, '19; Oxford, No. 6923, June 25, '24.

Physalis heterophylla var. *Nyctaginea* (Dun.) Rydb. The least frequent form. Again collected, this time at Farmington, Nos. 7626 and 7629, September 9, '25.

Pedicularis Canadensis Linn. Lousewort. A very common plant in copses and on banks. Near Utica, No. 7330, May 13. It has been collected before as follows: Keweenaw County, No. 768, July 25, '90; Ypsilanti, No. 768a, May 11, '91; Detroit, No. 768b, June 2, '93; Orion, No. 768c, May 30, '95; Parkedale, No. 3395, May 25, '13, and No. 3847, Aug. 23, '14.

Pedicularis Canadensis f. *preclara* A. H. Moore. A red flowered form of the Lousewort. With the species but not so common. Near Utica, No. 7331, May 13. It has been collected before at Parkedale, No. 3965, June 6, '15.

Plantago major Linn, var. *minima* (D. C.) Dcne. A very small state of the species with mostly small entire or denticulate suborbicular, ovate or oval leaves on very short petioles and peduncles shorter than the leaves, the ovoid, capitate or oblong spikes slightly overtopping them or some shorter. Belle Isle, No. 1864, August 30, '04. Algonac, *Gladewitz and Farwell*, No. 7081, September 3, '24. Shores of Torch Lake, No. 7469, July 20, 1925. In sand pits at Rochester, No. 7663, September 30.

Plantago major Linn, var *paniculata* Dcne. The form in which the spike, often branched, has foliaceous bracts at its base. Frequent throughout. Shores of Torch Lake, No. 7473, July 20, 1925.

Plantago Purshii R. & S. In yellow sand that was once beach sand. Algonac, No. 7419, June 17.

Plantago Virginica Linn. With the preceding species. No. 7420, June 17.

Galium circaezans Mx., var. *glabrum* Britt. Wild Licorice. The whole plant is very sparingly pubescent and the flowers are glabrous. In thin, grassy woods at Maybee, No. 7441, June 24.

Sambucus racemosa Linn, var. *pubens* (Mx.) Koehne. Redberried Elder. The leaves vary in shape and color but usually the leaves of an individual plant are alike. They are narrowly ovate-lanceolate, long-acuminate, yellowish green, pubescent; or oval, short acuminate, the terminal often obovate or oblanceolate, dark-green above and very pale beneath, glabrate. Both forms are found near Milan, but not in the same woods. The former, No. 7312 and the latter No. 7313, May 6.

Viburnum Acerifolium Linn, var. *ovatum* Rehder. This variation with ovate, undivided leaves was found by *Billington, Farwell and Gladewitz* in woods near Lakeville, No. 6443 1-2, October 11, '22, and by *Farwell and Gladewitz* at Northville, No. 6457, October 18, '22. The variety, as found here in Michigan, will generally show two or three leaves on each shrub that are 3-lobed, as in the typical species.

Lonicera Morrowii A. Gr. Looks much like *L. Tartarica* but the leaves are very pubescent and the white flowers tinged with red quickly fade yellow. An escape to the banks of the Huron river at Ypsilanti. No. 7364, May 27, 1925.

Cucumis sativus Linn. Cucumber. Waste grounds and roadsides near Sheldon, No. 7510, August 12, 1925.

Specularia perfoliata (Linn) A. DC. Venus' Looking Glass. Said to be scarce in Michigan. Usually it is found in sandy or gravelly grounds. Algonac, No. 7433, June 17. Associated with *Coreopsis grandiflora* and *Centaurea Cyanus* at Flat Rock, No. 7460, July 1; we collected it previously at South Rockwood, No. 5444 1-2, June 14, '21; also by myself on Belle Isle, No. 1461, June 22, '94; Parkedale Farm, No. 3471, June 15, '13 and No. 3515, July 20, '13.

Lobelia Kalmii Linn, var. *strictiflora* Rydb. There is in Michigan a small form of this species that agrees in every respect with the description of this variety. Clifton, No. 7480, July 21, '25; Farmington, September 9, 1925. The linear leaves and the flowers are erect, giving it a different aspect from the typical form of the species with these parts spreading.

Laciniaria Gladewitzii n. sp. An exact intermediate between *L. cylindracea* and *L. scariosa* var. *sphaeroidea* and probably a hybrid of these. Stem about 2.5 feet high, smooth

below, puberulent above; leaves smooth, the lower linear lanceolate 10 inches by .5 inch or less, the upper reduced and linear, punctate; spike of numerous, short peduncled, turbinate- cylindric heads, the involucral scales obovate, rounded at the apex, scarious margined, often colored; papus very plumose. It looks like a rather narrow leaved *L. sphaeroidea* with nearly the flower heads of *L. cylindracea*. Dry hills at Rochester, No. 7584, July 26. Associated with it were *L. cylindracea* (No. 7585), *L. scariosa* (No. 7586) and its var. *sphaeroidea* (No. 7587). Named for Mr. Bruno Gladewitz, who first observed its peculiarities and suggested its hybrid origin.

Grindelia squarrosa (Pursh) Dun. Gum Plant. It has been used in medicine in the treatment of intermittent fevers. In August, 1921, acres of it were observed in Newaygo Co., it has been collected at Marquette, No. 1836, Aug. '04; Detroit, No. 1836a, Aug. 11, '05; near Royal Oak, No. 4209, June 19, '16, and No. 4344, August. 10, '16.

Solidago lepida D. C. Banks and streams near Rochester, No. 7667, Sept. 30. The var. *fallax* Fernald was collected in Keweenaw Co., No. 491, Sept. 12, '86.

Solidago graminifolia (Linn) Salib. The typical form of the species was gathered at Clifton, No. 7481, July 21, 1925.

Aster Lowrieanus Porter. Frequent in copses near Rochester, Nos. 7655, blue-rayed and 7656 white-rayed, Sept. 30.

Aster laevis Linn, var. *panduratus* Farwell. Roadsides at Oxford. No. 7603, Sept. 2.

Aster laevis Linn, var. *thyrsoideus* Farwell. A low plant with a compact and small thyrsoid pannicle. Ypsilanti, No. 7687, Oct. 14, 1925.

Iva Xanthiifolia Nutt. Marsh Elder. At Flat Rock where some of the plants are 8 feet in height with leaves often 9 inches long and 8 wide. No. 7494, July 29.

Ambrosia coronopifolia T. & G. Ragweed. Previously reported as *A. psilostachya*. Rarely over a foot in height. Clifton, No. 1784 bis, July 21, 1925. It differs from *A. psilostachya* in its low stature, few or no papillate hairs, in its small staminate heads, and in its usually simple habit.

Rudbeckia hirta Linn. Black Eyed Susan. A very peculiar specimen of this species was gathered near Disco; it was stemless and had one head sessile in the middle of a rosette

of root leaves which had petioles of varying lengths. Near Disco, No. 7529, Aug. 19. Another form was observed at Rochester that had rays yellow and orange with a white band between.

Rudbeckia aspera Pers. We found two new stations for this Blackeyed Susan. Rochester, No. 7589, Aug. 26, and Goodison, No. 7673, Sept. 30.

Coreopsis tinctoria Nutt. Fields near the railway at Flat Rock, No. 7456, July 1.

Coreopsis coronata Hook. With the preceding. Scarce. No. 7455, July 1.

Coreopsis grandiflora Nutt. This plant has hairy stems and all the leaves are pinnatified. It covers an acre of ground, more or less, and is thoroughly established. The ground apparently was once under cultivation, but if so, it has long been abandoned as a garden. Flat Rock, No. 7457, July 1. It is said that Mr. Ford had about a bushel of seeds of various species planted here some three or four years ago, but most of them, left to themselves, have run out. The above have persisted; but the *C. coronata* probably will disappear in another year or two.

Artemisia Absinthium Linn. Wormwood. Occasional throughout the State. Frequent along roadsides near Goodrich, No. 7645, September 23. I have it from Clifton, No. 834, August 30, '90; Lake Linden, No. 5966, August 10, '21; Calumet, No. 5974, August 17, '21; and Roseville, No. 6863, October 10, '23.

Gaillardia pulchella Foug. Cultivated and escaped near Rochester. Spreading. No. 7654, September 30. *Chandler and Gladewitz* found this in fields near Pontiac in 1919.

Matricaria suaveolens (Ph.) Buchenau. Along the railway tracks at Commerce where it gave evidence of becoming plentiful. No. 7382, June 3.

Chrysanthemum Parthenium (Linn) Bernh. The Feverfew of the gardens is an escape at Eagle River. No. 7490, July 21, 1925.

Cirsium Canadense (Linn) Scop., var. *integrifolium* Wimm. and Grab. This flat leaved form was collected along roadsides at Raisinville; No. 7498, July 29. The flower heads

are longer and more flask-shaped. Mr. Gladewitz collected it at Wayne, August 12, 1925.

Centaurea Cyanus Linn. Bachelor's Button. Associated with *Coreopsis grandiflora* at Flat Rock, No. 7459, July 1.

Cochorium Intybbs Linn, var. *divaricata* DC. Chicory. This is a variety with many of the flowers on clubshaped peduncles. Near Sheldon, No. 7511, August 12, 1925; Detroit, No. 1650, August 4, '99.

Sonchus arvensis Linn, var. *maritima* Wahl. Green, not glaucous, peduncles and involucres glandless. Very variable in the size of its leaves on plants growing side by side (5 ins. by .75 to 14.5 by 3.5), mostly undivided, oblong-lanceolate or lanceolate. A large stand of it at Washington, No. 7523, August 19.

Lactuca Serriola Linn. Prickly Lettuce. Everywhere common. This specific name has seven years' priority over that of *Scariola* and is the name to be adopted. Leaves, obovate, pinnatified, vertical but usually some are horizontal and frequently the uppermost are oblong, entire and acute. The annual stems are simple, while the biennial plants may be branched at the base; some plants have entire leaves throughout but are to be placed here on account of the *obovate, obtuse* leaves, some of which may be slightly three lobed at the apex. Near Goodrich, No. 7638, September 23, Goodison, No. 7640, September 30. I have collected it at Rochester, No. 2091, June 30, '09; at Trenton, No. 2091a, August 8, '10; at Detroit, No. 2222 1-2, July 22, '11.

Lactuca Serriola var. *integrata* (Gren. and Godr.) n. comb. (*L. Scariola* var. *integrata* Gren. and Godr.) Leaves oblong, acute, none pinnatifid. More abundant than the specific type. Goodison, No. 7641, September 30. I have collected it at Ypsilanti, No. 1197, August 12, '91, and on Belle Isle, 1197a, August 12, '92. The variety *integrata* occasionally has all the leaves without prickles on the midrib underneath and this form may be known as subvar. *plicata* (Balb.) n. comb. (*L. plicata* Balb.) Goodrich, No. 7639. September 23.

OBITUARY

Mark Alfred Carleton, the well-known vegetable pathologist, died April 26 last year in Paita, Peru, from an attack of malaria. He was born near Jerusalem, Ohio, on the 7th of March, 1866. In 1876 his parents moved to a farm in Cloud County, Kansas. His early education was obtained in the rural schools of Ohio and Kansas. He entered the Kansas Agricultural College in 1884, graduating with the degree of Bachelor of Science in 1887. During 1890-1891 he was Professor of Natural History in Garfield University at Wichita, Kansas; during 1891 and 1892 he taught natural history in Wichita University, and during 1892-1893 took a graduate course in botany and horticulture at the Kansas Agricultural College, receiving the degree of Master of Science. During 1893 he was Assistant Botanist at the Kansas Experiment Station, giving special attention to plant pathology and particularly to cereal rusts. In March, 1894, Mr. Carleton began his service in the United States Department of Agriculture as Assistant Pathologist, and in 1901 he was appointed Cerealist in charge of Grain-investigations in the Bureau of Plant Industry, a position which he held until May 1918. During 1898 and 1900 he was an Agricultural Explorer in eastern Europe and Siberia, in search of rust-resisting and drought-resisting cereals.

Before entering the U. S. Department of Agriculture Mr. Carleton had published some reports on rusts of grains, several lists of Kansas Parasitic Fungi, and on various flowering plants of Oklahoma, etc. It was under the auspices of the Department of Agriculture that he published his excellent papers on plant pathology, establishing the physiological relationships of nearly all the cereal rusts of this country, and showing that durum wheats, emmer, einkorns and some other wheats are more or less rust-resistant.

It was Mr. Carleton who began the introduction of new varieties of cereals from Europe and Siberia into this country, and his work proved an immense success, His paper "The basis for the improvement of American wheats" (Wash-

ington 1900, Bull. 24, U. S. Dept. Agriculture) gives an idea of the magnitude of his work in this direction, and he is the author of a series of similar papers, all of which were elaborated with rare skill and extraordinary care. After leaving the service of the Department Mr. Carleton undertook some important work with the Grain Corporation of America, where he rendered excellent service. Leaving the Grain Corporation he entered the service of the United Fruit Company and was sent to Central America to study banana diseases. Near Port Limon he developed a laboratory and conducted some important field investigations in the selection of disease-resisting bananas. In 1922 he severed his relations with the Fruit Company, and was called to British Honduras for pathological work. He remained in British Honduras until December, 1924, when he went to Peru in connection with a large project having for its object the production of cotton and other crops in Peru, and was making special studies of cotton diseases at the time of his death.

It is indeed astonishing to see what an immense field Mr. Carleton covered in so short a period as twenty-five years, especially considering his very modest education in natural science.

Mr. Carleton was a very energetic man, full of inspiration and always active, and his keen eye for nature guided him to accomplish what he did. He performed his work in a purely scientific, very simple and quiet way, with his mind completely concentrated on whatever problem he had in view. His kind and friendly disposition makes his death a severe loss to his friends. His great work in plant pathology and his introduction of Eurasian cereals to this country has secured him a most prominent place in the history of American botany and American agriculture.

Theo. Holm, Clinton, Maryland.

The American Midland Naturalist

PUBLISHED BI-MONTHLY BY THE UNIVERSITY
OF NOTRE DAME, NOTRE DAME, INDIANA

Vol. X MARCH and MAY, 1926. Nos. 2 and 3.

THE MISSOURI SPECIES OF ELYMUS.

By BENJAMIN FRANKLIN BUSH.

It has long been apparent to every one attempting to name *Elymus* specimens, and to authors of local floras and lists, that there was something radically wrong with our understanding of the species of this genus.

The cause of this misunderstanding was through a misconception of *E. canadensis, E. glaucifolius* and *E. virginicus* by Scribner in Gray's Manual 6th edition, in the first place, mainly, and by Hitchcock in the Robinson and Fernald edition of Gray's Manual, 1908, and lastly by Nash in the second edition of Britton and Brown's Illustrated Flora, 1913. These authors in all their writings invariably refused to recognize *E. glaucifolius*, the most common and the most widely distributed, as well as the most variable species of the genus; and they accepted as species without question, forms that are not even worthy of varietal rank.

No one of these authors ever understood *E. canadensis* or knew what *E. glaucifolius* was, although Hitchcock in the Robinson and Fernald edition of Gray's Manual says that var. *glaucifolius* of *E. canadensis*, "corresponds more nearly with the Linnean type," when in reality the *E. canadensis* of Hitchcock in this work is really *E. glaucifolius* of Muhlenberg.

Dr. Wiegand in his paper,[1] has shown that *E. canadensis* does not extend farther west than central New York, and is comparatively rare throughout its range, and that the great-

[1] K. M. Wiegand, some Species and Varieties of *Elymus* in eastern North America, Rhodora *20*:1918.

er part of what has been passing for *E. canadensis* is *E. robustus* and an undescribed species, which he describes as *E. riparius*.[2]

Dr. Wiegand curiously overlooked the fact that the type specimens of *E. glaucifolius* came from Pennsylvania, probably from near Philadelphia, and Philadelphia is a long ways from central New York; and further, he states that he has seen no specimens of *E. canadensis* from Pennsylvania. No doubt Dr. Wiegand was misled by Hitchcock's misidentification of Muhlenberg's specimens of *E. glaucifolius*, but if he had stopped a moment to consider this, he would have seen that Muhlenberg's *E. glaucifolius* could not be the same as Linnaeus' *E. canadensis*, which is a species of New England, and that it was the same or nearly the same as the plant Hitchcock called *E. robustus* in the Robinson and Fernald Manual, and which he there gives as its range Illinois and westward. Dr. Wiegand confused *E. glaucifolius* with *E. robustus* in his paper, for he says there that *E. robustus* ranges from Grafton County, New Hampshire, to Vermont, Massachusetts and Connecticut; also from Illinois and Michigan to Montana, Colorado, Texas and New Mexico.[3] This leaves quite a strip of the Eastern States not accounted for. This is readily understood when we take into consideration the fact that Wiegand had in hand the real *E. glaucifolius* of the East, and the robust form of the prairie regions that Scribner and Smith had described as *E. robustus*, the former being the *E. canadensis* of Hitchcock in the Robinson and Fernald Manual, but not the *E. canadensis* of Linnaeus. I have examined some 500 or 600 specimens from the central and eastern States that were labeled *E. canadensis*, and of this large number I found three sheets of the real *E. canadensis*, two sheets were *E. riparius* and the remainder were *E. glaucifolius*, or one or the other of its forms. I have examined and observed in the field thousands of plants growing, and contrary to my expectation, the species and varieties or forms herein considered were remarkably constant, so

[2] Wiegand, l. c. 84.1918.

[3] Wiegand, l. c. 89.1918.

much so that I was never at a loss to place any plant, or clump of plants that I saw in the field.

The species and forms observed and studied in the field the past two summers, did not all flower at the same time, but some flowered early and some flowered later, and a study of these flowering periods might be productive of good results if taken up and followed for several seasons.

The usual number of species of *Elymus* credited to Missouri was about twelve, and this number is certainly too large for this genus.

I have been compelled to reduce the number of species of *Elymus* found in Missouri to six, with six varieties or forms, and it may be that a still greater reduction in the number of the species will be necessary when the forms are better studied.

In the course of this study of the species of *Elymus* of Missouri, I have had the advantage of studying the large amount of material in the Herbarium of the University of Illinois, the private collection of Mr. Charles C. Deam, of Bluffton, Indiana, that of Mr. Kenneth K. Mackenzie of Maplewood, New Jersey, some one hundred or more sheets from the United States National Herbarium, Washington, D. C., the large collection of the Herbarium of the University of Minnesota, and a small collection from Mr. E. J. Palmer of Webb City, Missouri.

For the many courtesies extended me by the loan of this great amount of material for study, I am under obligations to Professor William Trelease, Dr. C. O. Rosendahl of Minneapolis, Minnesota, Mrs. Agnes Chase, of the Department of Agriculture, Washington, D. C., Mr. Kenneth K. Mackenzie, Mr. Charles C. Deam, and Mr. E. J. Palmer, to all of whom, and to my friends and correspondents, I herein desire to acknowledge their assistance and express my thanks for aid received.

Having seen and examined more than one thousand specimens of *Elymus* in the course of my two seasons study, I present for the species found in the State the following:

KEY TO THE MISSOURI SPECIES OF ELYMUS

1. Spikelets appressed to the rachis; spikes narrow, very slender; glumes and lemmas long-armed, smooth; culms slender, moderately tall, smooth; leaves short, narrow, erect.
   1. ELYMUS MACKENZII
1. Spikelets spreading; spikes usually stout, sometimes very broad; glumes and lemmas more or less variable in the same species; leaves long, broad, spreading; culms usually stout, usually tall. 2.
2. Awns straight when mature and dry; palets 6-8 mm. long, or rarely longer in some forms of *E. virginicus;* leaves thin, scarcely striate, 5-12 mm. wide, not or scarcely involute when dry. 3.
2. Awns curved outwards toward the apex when mature and dry; palets 9-11 mm. long; leaves firm, thick, striated, 5-20 mm. wide, strongly involute, at least when dry. 10.
3. Glumes and lemmas broad, the gormer indurated and more or less curved at the white or yellowish base. 4.
3. Glumes and lemmas narrow, often setiform, the former indurated and terete below, essentially straight. 9.
4. Glumes and lemmas muticous, or with awns very short, seldom more than one-fourth their entire length. 2D. *Elymus virginicus submuticus.*
4. Glumes and lemmas awned, the awns usually one-half their entire length, sometimes longer, rarely shorter. 5.
5. Glumes 10-25 mm. long. 6.
5. Glumes over 25 mm. long; spikes exserted. 8.
6. Glumes and lemmas villous-hirsute. 2A. *Elymus virginicus intermedius.*
6. Glumes and lemmas glabrous, or merely scabrous on the margins. 7.
7. Spikes usually included at the base in the enlarged upper sheath, usually slender and closely flowered. 2. *Elymus virginicus.*
7. Spikes usually long-exserted, thicker, the spikelets more stiff and spreading. 2c. *Elymus virginicus jejunus.*
8. Glumes and lemmas glabrous or merely strigose-scabrous;

glumes wider, over 1 mm. wide, much curved and indurated at the striated whitish base. 2B. ELYMUS VIRGINICUS GLABRIFLORUS.

8. Glumes and lemmas villous-hirsute; Glumes narrow, under 1 mm. in width, somewhat curved at the unstriated yellowish base; upper sheath scarcely enlarged. 3 ELYMUS AUSTRALIS.

9. Glumes and lemmas villous-hirsute, the former very narrow, sometimes almost setiform. 4. ELYMUS STRIATUS.

9. Glumes and lemmas glabrous, or merely strigose-scabrous, the former wider than those of No. 4. 5. ELYMUS ARKANSANUS.

10. Spikes erect, thick; plants flowering earlier than the other two forms. 6B. ELYMUS GLAUCIFOLIOUS ROBUSTUS.

10. Spikes nodding or drooping. 11.

11. Spikes very thick, nodding; plants flowering very late, later than the other two forms. 6. ELYMUS GLAUCIFOLIUS.

11. Spikes long and slender, drooping; plants flowering somewhat earlier than the typical form. 6A. ELYMUS GLAUCIFOLIUS CRESCENDUS.

1. ELYMUS MACKENZII B. F. Bush, n. sp.

Culms very slender, moderately tall, 9-12 dm. high; sheaths close, not inflated, smooth; leaves light green, 1-2 dm. long, 4-8 mm. wide, smooth beneath, densely pubescent above with long whitish hairs; spikes long-exserted, slender, about 5 mm. thick; spikelets appressed to the rachis, single at each joint of the rachis, or the lower sometimes in pairs, 1-3-flowered; glumes 2, 3 or 4 at each joint of the rachis, awl-shaped; the body of the glume about 9 mm. long, strongly 5-7-nerved, with a slender awn 6-8 mm. long; lemmas lanceolute, smooth, or roughly 5-nerved at the apex, about 9 mm. long, each with a slender awn 20-30 mm. long; palets thin, 7-9 mm. long.

Plants growing singly or two or three together, never in clumps, on the bare faces of high rocky bluffs along the White River in Barry County, Missouri. No doubt occurring all along the White River bluffs in northwestern Arkansas. Named for Mr. Kenneth K. Mackenzie, who, in company with

the writer, first noted this peculiar species of *Elymus* at the type locality.

Type, *Bush* 77, Eagle Rock, Missouri, June 15, 1897, U. S. N. Herb. No. 318128; cotypes in Herbarium of Missouri Botanical Garden, Sheet No. 119875, and in Herbarium of Kenneth K. Mackenzie.

This has been referred to both *E. Macounii* and *E. glaucus*, but differs conspicuously from both these species, and furthermore, is clearly outside of the known range of these species. The specimens collected in June, 1897, were determined by myself and Mr. Mackenzie as *E. Macounii*, and distributed under that name, which no doubt caused Nash to cite *E. Macounii* for Missouri in the Illustrated Flora, 289, 1913, but the range he there ascribes to *E. Macounii* could not possibly include Missouri. I have examined many specimens of *E. Macounii* from Montana, Western Nebraska, New Mexico, Nevada, Colorado, North Dakota, South Dakota, Oregon, Washington, Wyoming, Idaho and Saskatchewan. The type "Great Plains of British America," is far from extreme southern Missouri, and is about as much like Barry County, Missouri, as the Llano Estacado is like Virginia. The specimens sent to the United States National Herbarium were labeled *E. Macounii*, but the specific name was crossed out, and the name *glaucus* written on the label by Hitchcock, but the range of *E. glaucus* as given by him in the Robinson and Fernald Manual in 1908 does not include Missouri by more than 500 miles. I have had many sheets of specimens of *E. glaucus* to examine, from California, Western Colorado, Washington, Oregon, Montana, North Dakota, Idaho, Nevada, Wyoming and Vancouver. The type locality of *E. glaucus*, "Columbia River" (probably Oregon or Washington), is more than 2000 miles from southern Missouri, and the floras of the two regions are about as unlike, as are the floras of Maine and Texas.

2. ELYMUS VIRGINICUS L. Sp. Pl. 84. 1753.

REFERENCES:

ELYMUS VIRGINICUS L. Sp. Pl. 84 (1753); Bush, Flora of Jackson County, Missouri, Suppl. 901 (1885); Tracy, Flora

of Missouri, 1733 (1886); Eggert, Catalogue of Plants of Saint Louis, Missouri, 8 (1891); Dewey, Coulter, Manual of the Plants of Western Texas *3*:550 (1894); Mackenzie and Bush, Manual of the Plants of Jackson County, Missouri, 38 (1902); Nash, Small, Flora, 160 (1913); Nash, Britton and Brown, Illustrated Flora, *1*:291 (1913); Palmer, Flora of Jasper County, Missouri, 365 (1916); Wiegand, Rhodora *20*:83 (1918).

"*E. sibiricus* L," Bush, Flora of Jackson County, Missouri, 580 (1882). "*E. Sitanion* Schultz," Tracy, Flora of Missouri, 1730 (1886). "*E. glaucus* Buckley," Palmer, Flora of Jasper County, Missouri, 365 (1916). *E. carolinianus* Walter, Flora Carol. 82 (1788). *E. nitidus* Vasey, Bull. Torr. Club *13*:120 (1886). *E. virginicus minor* Vasey, Contr. U. S. Nat. Herb. *2*:550 (1891).

TYPE LOCALITY: Virginia.

Nova Scotia and New Brunswick to Manitoba, south to Florida and Texas, Nash, l. c. 156, 1905.

Nova Scotia to Florida, and westward, Hitchcock, l. c. 169, 1908.

Nova Scotia to Manitoba, south to Florida and Texas, Nash, l. c. 291, 1913.

Nova Scotia and New Brunswick to Manitoba, Florida and Texas, Nash, l. c. 160, 1913.

Newfoundland and Quebec to District of Columbia, westward to Montana and Colorado, southward to Louisiana and Texas, Wiegand, l. c. 83, 1918.

A very variable species, having the greatest range of forms of any North American species of Elymus, as well as having the greatest range, presenting many forms in this State, some of which have been recognized as species by different writers, all of the varieties here presented being generally recognized as species, but I have seen too many intergrading specimens between all of the forms, that I think it would be better to regard them as varieties, if indeed, some of them can lay claims for more than mere forms.

SPECIMENS EXAMINED:

MAINE

Orono, *Knight*, August 10, 1084, M. Herb.[4]

CONNECTICUT

Southington, *Bissell*, August 3, 1902, D. Herb.

NEW JERSEY

Millburn, *Mackenzie* 314, July 26, 1903, M. Herb.; South River, *Mackenzie* 3766, August 23, 1908, M. Herb.; Wildwood, *Chase* 3510, July 25, 1906, U. of Ill., Herb.; Woodbridge, *Lighthipe*, August 11, 1891, U. of Minn. Herb.

DISTRICT OF COLUMBIA

Anacostia, *Pollard* 425, June 23, 1895, U. of Minn. Herb.; Anacostia, *Pollard* 425, June 23, 1895, U. of Minn. Herb.

VIRGINIA

Cumberland County, *Stevens* 6846, June 14, 1902, U. S. N. Herb. No. 1020416; Four mile Run, *Chase* 2449, July 19, 1904, U. of Ill. Herb.; Jackson City, *Steele*, May 19, 1902, U. S. N. Herb. No. 557848; Potomac River, *Ball* 793, June 28, 1902, U. S. N. Herb. No. 730994; Potomac River, *Ball* 793, June 28, 1902, U. S. N. Herb. No. 1020407.

INDIANA

Angola, *Deam* 52531, August 29, 1920, D. Herb.; Baum Bridge, *Deam* 26473, September 15, D. Herb.; Cannelton, *Deam* 16634, June 19, 1915, D. Herb.; Carmel, *Deam* 9522, August 8, 1911, D. Herb.; Chrisney, *Deam*, 28353, July 18, 1919, D. Herb.; Chrisney, *Deam* 28968, August 13, 1919, D. Herb; Chrisney, *Deam* 28968, August 13, 1919, D. Herb.; Decker, *Deam* 32853, September 21, 1920, D. Herb.; Deer-

[4] For convenience I have used the following abbreviations: M. D., and P. refer to the collections of Mackenzie, Deam and Palmer; U. S. N. the United States National Herbarium; U. of Minn., the University of Minnesota; U. of Ill., the University of Illinois; F. M. of N. H., the Field Museum of Natural History; M. B. G., the Missouri Botanical Garden.

field, *Deam* 15381, September 13, 1914, D. Herb.; Erie County, *Deam*, July 12, 1903; Goldsmith, *Deam* 15348, September 3, 1914, D. Herb.; Hillsdale, *Deam* 9838, August 27, 1911, D. Herb.; Huntingburg, *Deam* 28322, July 18, 1919, D. Herb.; Indianapolis, *Deam* 13544, July 2, 1913, D. Herb.; Kentland, *Deam* 21558, August 30, 1916, D. Herb.; Lafayette, *Deam* 11672, July 20, 1915, D. Herb.; Laketon, *Deam* 22038, September 18, 1916, D. Herb.; Leavenworth, *Deam* 20404, June 22, 1916, D. Herb.; Leesburg, *Deam* 33489, October 1920, D. Herb.; Manville, *Deam* 16210, June 20, 1915, D. Herb.; Mollie, *Deam* 322, August 13, 1905, D. Herb.; Mongo, *Deam* 32476, August 28, 1920, D. Herb.; Monticello, *Deam* 32197, August 22, 1920, D. Herb; Mount Union, *Deam* 16814, July 3, 1915, D. Herb.; Mount Vernon, *Deam* 33037, September 25, 1920, D. Herb.; Ontario, *Deam* 15046, August 30, 1914, D. Herb.; Perrysville, *Wright*, June, 1893, U. of Minn. Herb.; Petersburg, *Deam* 16961, July 7, 1015, D. Herb.; Pleasant Mills, *Deam* 32573, August 31, 1920, D. Herb.; Prairietown, *Deam* 32903, September 17, 1920, D. Herb.; Remington, *Deam* 11817, July 30, 1912, D. Herb.; Schneider, *Deam* 18143, August 24, 1915, D. Herb.; Shelton, *Deam* 25474, June 18, 1918, D. Herb; Wells County, *Deam*, August 24, 1902, D. Herb.; Weston, *Deam* 28081, July 14, 1919, D. Herb.; Wilder, *Deam* 32220, August 23, 1920, D. Herb.; Wilder, *Deam* 32221, August 23, 1920, D. Herb.; Yankeetown, *Deam* 16725, July 2, 1915, D. Herb.

ILLINOIS

Akron, *Chase* 68, July 12, 1887, U. of Minn. Herb.; Chicago, *Moffatt*, August 27, 1889, U. of Ill. Herb.; Chicago, *Moffatt* 310, August 27, 1893, U. of Minn. Herb.; Decatur, *Clokey*, August 1, 1898, U. of Ill. Herb.; Du Page County, *Moffatt*, August 13, 1892, U. of Minn. Herb.; Glencoe *Sherff* 1736, August 20, 1912, U. of Ill. Herb.; Mahomet, *Gibbs* and *Clinton*, October 10, 1898, U. of Ill. Herb.; Mount Carmel, *Schneck*, June 1879, U. of Ill. Herb.; Mount Carbel, *Schneck*, July 28, 1900, U. of Ill. Herb.; No locality given, *Schneck*, date not given, U. of Ill. Herb.; Peoria, *Brendel*, date not given, U. of Ill. Herb.; Peoria, *McDonald*, August, 1903, U.

of Ill. Herb.; Urbana, *Seymour*, August 3, 1880, U. of Ill. Herb.; Wabash County, *Schneck*, June 30, 1878, U. of Ill. Herb.; Wabash County, *Schneck*, July 17, 1879, U. of Ill. Herb.; Wabash County, *Schneck*, June 29, 1904, U. of Ill. Herb.; Wabash County, *Schneck*, June 27, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1599, August 17, 1907, U. of Ill.; Herb.

MISSOURI

Aberdeen, *Davis*, September 11, 1911, U. of Ill. Herb.; Aberdeen, *Davis* 1143, September 24, 1911, U. S. N. Herb.; No. 673982; Allenton, *Letterman*, July 20, 1883, U. S. N. Herb. No. 986185; Allenton, *Letterman*, August 1, 1883, U. S. N. Herb. No. 986184; Carruthersville, *Hitchcock*, month not given(1904, U. S. N. Herb.; No. 731052; Courtney, *Bush* 795, July 11, 1896, U. S. N. Herb; No. 282374; Courtney, *Bush* 817, August 1, 1900, U. S. N. Herb. No. 386727; Courtney, *Bush* 1153, September 10, 1901, M. Herb.; Courtney, *Bush* 8392, June 14, 1918, U. of Ill. Herb.; Courtney, *Bush* 8443, June 29, 1918, U. of Ill. Herb.: Courtney, *Bush* 8406, June 17, 1918, U. of Ill. Herb.; Courtney, *Bush* 8471, July 9, 1918, U. of Ill. Herb.; Courtney, *Bush* 9098, August 12, 1920, U. of Ill. Herb.; Courtney, *Bush* 9104, August 12, 1920, U. of Ill, Herb.; Courtney, *Bush* 9134, August 20, 1920, U. of Ill. Herb.; Courtney, *Bush* 9339, October 22, 1920, U. of Ill. Herb.; Creve Coeur Lake, *Sherff* 513, July 17, 1910, U. S. N. Herb.; No. 288679; Creve Coeur Lake, *Sherff* 513, July 17, 1910, U. S. N, Herb. No. 288680; Floyd, *Bush* 9398, July 11, 1921, U. of Ill. Herb.; Hannibal, *Davis*, September 11, 1911, U. of Ill. Herb.; Medill *Bush* 9163, August 24, 1920, U. of Ill. Herb.; Neck City, *Palmer* 18126, July 1, 1920, P. Herb.; Neck City, *Palmer* 18127, July 1, 1920, P. Herb.; Oakwood, *Davis* 1316, October 4, 1911, U. S. N. Herb. No. 674012; Sheffield, *Mackenzie*, July 29, 1901, M. Herb.; Springfield, *Standley* 8359, August 29, 1911, U. S. N. Herb. No. 687319; Springfield, *Standley* 9154, August 21, 1912, U. S. N. Herb. No. 688072; Strafford, *Standley* 9456, August 27, 1912, U. S. N. Herb. No. 688372; Webb City, *Palmer* 15987, July 30, 1918, P. Herb.; West-

port, *Mackenzie*, June 25, 1896, D. Herb.; Westport, *Mackenzie*, June 25, 1896, M. Herb.; Westport, *Mackenzie*, June 25, 1896, U. of Minn. Herb.

NORTH CAROLINA

Stotesville, *Hyams*, date not given. U. of Minn. Herb.

SOUTH CAROLINA

Simpson's Mill, *Davis* 7906, August 29, 1917, U. of Ill. Herb.

MICHIGAN

Alma, *Davis*, date not given, U. of Ill Herb.; Jackson County, *Camp*, July 13, 1895, U. of Minn. Herb.; Jackson County, *Camp*, July 13, 1895, U. of Minn. Herb.

IOWA

Fayette, *Fink*, July 29, 1893, U. of Minn. Herb; Muscatine, *Mackenzie*, September 8, 1894, M. Herb.

MINNESOTA

Hennepin County, *Aiton*, August, 1887, U. of Minn. Herb; Hennepin County, *Aiton*, August, 1889, U. of Minn. Herb.; Heron Lake, *Skinner* 303½, June, 1902, U. of Minn. Herb.; Jefferson, *Wheeler* 418, July 26, 1899, U. of Minn. Herb.; Jordan, *Ballard* 389, July, 1891, U. of Minn. Herb.; Minneapolis, *Oestlund*, July, 1886, U. of Minn. Herb.

KANSAS

Argentine, *Mackenzie*, June 26, 1896, M. Herb.; Argentine, *Mackenzie*, June 28, 1896, M. Herb.; Argentine, *Mackenzie*, June 28, 1896, M. Herb.; Rosedale, *Mackenzie*, July 12, 1896, M. Herb.

NEBRASKA

No locality given, *Hayden*, 1853-1854, U. of Minn. Herb.; Redland, *Bates* 5662, August 4, 1912, U. of Minn. Herb.

SOUTH DAKOTA

Lake Ibsen, *Lunell*, September 4, 1899, M. Herb.; Lake Ibsen, *Lunell*, July 28, 1900, U. of Minn. Herb.; Lake Ibsen,

Lunell, August 15, 1906, D. Herb.; *Lunell*, August 15, 1906, U. of Ill. Herb.; Lake Ibsen, *Lunell*, July 26, 1915, D. Herb.; Lake Ibsen, *Lunell*, 181, July 26, 1915, U. of Ill. Herb.; Turtle Mountains, *Lunell*, July 21, 1905, D. Herb.; Turtle Mountains, *Lunell*, July 21, 1905, M. Herb.

GEORGIA

Banks of the Coosa, *Chapman* 23, month not given, 1883, U. S. N. Herb. No. 1020418; cited by Scribner and Ball as *E. glabriflorus*, but apparently not that variety.

ALABAMA

Montgomery, *Baker*, June 1, 1897, U. of Minn. Herb.

LOUISIANA

Alexandria, *Ball* 402, May 19, 1899, U. of Minn. Herb.

OKLAHOMA

Mountain Park, *Stevens* 1225, June 23, 1813, U. of Minn. Herb.; Stillwater, *Hitchcock* 1615, August 8, 1918, U. S. N. Herb. No. 103219.

TEXAS

Abilene, *Tracy* 8114, May 19, 1902, U. of Minn. Herb.; Dallas, *Reverchon* 1139, June 4, 1900, M. Herb.; Tarrant County, *Ruth* 52, June 10, 1913, U. of Ill. Herb.

NO STATE GIVEN:

Vermilion River, *Browhelm*, October 6, 1921, M. Herb.

2A. ELYMUS VIRGINICUS INTERMEDIUS (Vasey) n. comb.

REFERENCES:

ELYMUS VIRGINICUS INTERMEDIUS (Vasey) Bush. *E. canadensis intermedius* Vasey; S. Wats. & Coulter, A. Gray, Man. ed. 6, 673 (1890). *E. intermedius* (Vasey) S. & S. Bull. Div. Agrost. *4*: 38 (1891). *E. hirsutiglumis* Scribner, Bull, Div. Agrost. *11*: 58 (1898); Mackenzie and Bush, Manual of the Flora of Jackson County, Missouri, 38 (1902); Nash. Britton. Manual, 157 (1905); Nash, Britton & Brown, Illustrated Flora, *1*: 292 (1913). *E. virginicus hirsutiglumis* (Scribner) Hitchc.; Rhodora *10*: 65 (1908); Wiegand, Rhodora *20*: 83 (1918).

TYPE LOCALITY: No locality given.

Maine to Virginia and Nebraska, Nash, l.c. 157, 1905.

Maine to Virginia and Nebraska, Hitchcock l.c. 169, 1908.

Maine to North Carolina, Illinois and Nebraska, Nash, l. c. 160, 1913.

Maine to Virginia, Tennessee, Missouri and Nebraska, l.c. 292, 1913.

Maine to Pennsylvania, Nebraska and Missouri, Wiegand, l.c. 84, 1918.

Extreme forms of this variety look very distinct from *E. virginicus*, but there are so many intermediate specimens that it is best to consider it only a variety of that species. It does not resemble *E. canadensis* (i. e. *glaucifolius*) in the least, as that species has the awns of the glumes and lemmas curved outward toward the apex, and the glumes are flattish and but slightly indurated at the base. The name given to this variety clearly has precedence over Scribner's name, and I can not see why Wiegand accepted Hitchcock's combination, published 18 years later than Vasey's.

SPECIMENS EXAMINED:

MAINE

Cape Elizabeth, *Norton*, September 13, 1919, D. Herb.; Orono, *Knight*, August 7, 1904, M. Herb.

NEW YORK

Elmira, *Lucy*, 11752, July 22, 1895, U. of Minn. Herb.; Elmira, *Lucy* 11752, July 22, 1895, U of Minn. Herb.; Onondago, *Goodrich*, July 30, 1882, U. of Minn. Herb.

NEW JERSEY

Pequannock, *Mackenzie* 3807, August 30, 1908, D. Herb.

DISTRICT OF COLUMBIA

Little Falls, *Topping*, August 18, 1895, U. of Minn., Herb.; Washington, *Steele*, July 29, 1896, U. of Minn. Herb.

INDIANA

Clark County, *Deam* 26255, August 17, 1918, D. Herb.; Decatur, *Deam* 5362, September 8, 1908, D. Herb.; George-

town, 7625, September 28, 1910, D. Herb.; Rainesville, *Deam* *Deam* 7625, September 28, 1910, D. Herb.; Rainesville, *Deam* 32734, September 15, 1920, D. Herb.; Warren, *Deam* 32608, August 13, 1920, D. Herb.

ILLINOIS

Carlinville, *Andrews*, July 29, 1889, U. of Ill. Herb.; Mascoutah, *Welsh*, 1862-1871, U. of Ill. Herb.; Mount Carmel, *Schneck*, June, 1888, U. of Ill. Herb.; Taylorville, *Andrews*, July 25, 1898, U. of Ill. Herb.; Taylorville, *Andrews*, August 1, 1898, U. of Ill. Herb.; Wabash County, *Schneck*, September 4, 1904, U. of Ill. Herb.; Wady Petra, *Chase*, July 29, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1541, August 11, 1907, U. of Ill., Herb.

MISSOURI

Courtney, *Bush* 1740, July 11, 1902, U.S.N. Herb. No. 440193, closely approaching the specific form, but more nearly like specimens of the variety from the Eastern States; Courtney, *Bush* 1740, July 11, 1902, M. Herb., verging strongly towards *virginicus;* Courtney, *Bush* 9112, August 14, 1920, U. of Ill. Herb.; Martin City, *Mackenzie* 32, July 25, 1902, M. Herb.; Monteer, *Bush* 1125, October 23, 1901, M. Herb.; Sibley, *Mackenzie* 635, October 14, 1901, M. Herb., Swope Park, *Bush*, 9448, July 22, 1921, U. of Ill. Herb.; Swope Park, *Mackenzie* 433, September 13, 1908, M. Herb.

MICHIGAN

East Lansing, *Yuncker* 733, August 9, 1917, U. of Ill. Herb.

2. B. ELYMUS VIRGINICUS GLABRIFLORUS (Vasey) n. comb.

REFERENCES:

E. VIRGINICUS GLABRIFLORUS (Vasey) Bush. *E. canadensis glabriflorus* Vasey; Dewey, Manual of the Flora of Western Texas *3*:550 (1914), in great part. *E. glabriflorus* (Vasey) Scribner and Ball, Bull. Dev. Agrost. *24*:49 (1901); Nash, Britton Man. 2nd ed. Suppl. 1054, 1905; Nash, Britton & Brown, Ill., Flora, 2nd ed. *1*: 291, (1913); Palmer, Flora of

Jasper County, Missouri, 365 (1916). *E. australis glabriflorus* (Vasey) Wiegand, Rhodora *20*: 84 (1918).

TYPE LOCALITY: Central Texas to Georgia.

Pennsylvania to Tennessee and Georgia, west to New Mexico, Nash, l.c. 1054, 1905.

Massachusetts and Maryland to Florida, westward through Tennessee and Illinois to Nebraska and Texas, Wiegand, l.c. 83, 1918.

Differs from *E. virginicus* only in the long-awned glumes and lemas, some plants having these much longer than those of typical specimens of *virginicus*. The glumes and lemmas of this variety may be longer and straighter, narrower, less striated, and less curved than those of typical specimens of *virginicus*, but in such a polymorphous species these differences are not of sufficient importance to be of specific value. The type specimen of *E. virginicus* came from the coast region of Virginia, and is about as unlike the plant of the interior region in appearance, as the most extreme form of *E. virginicus intermedius* is unlike the same form, and yet no one has ever proposed to separate the interior prairie form from the coast plant. The typical form of *E. virginicus* as found along the coast from Massachusetts to Vriginia and Florida, is a plant having a very thick, stiff spike, the glumes and lemmas short and broad, and very thick, much curved, closely appressed to the rachis, and bears no resemblance whatever to the plant of the interior prairie region, nor to the variety *glabriflorus*, but an examination of any large collection of specimens of *Elymus* will show all degrees of intermediates between these three.

SPECIMENS EXAMINED: District of Columbia.

Bennings, *Steele*, July 2, 1900, U. S. N. Herb. No. 730988; Hamilton Hill, *Ball* 701, July 30, 1900, U. S. N. Herb. No. 731055; Tenallytown, *Kearney* 15, August 16, 1897, U. S. N. Herb, No. 1020406; Washington, *Steele*, July 31, 1896, U. of Minn. Herb.

VIRGINIA

Munden, *Mackenzie* 1675, September 3-19, 1905, M. Herb.; Norfolk, *Kearney* 293, August 5, 1895, U. S. N. Herb. No. 1020411.

TENNESSEE

Cowan, *Ruth* 23, July, 1898, M. S. N. Herb. No. 1020420.

MISSOURI

Joplin, *Palmer* 19098, September 17, 1920, P. Herb.; Noel, *Palmer* 19049, P. Herb.; Webb City, *Bush* 9076, August 7, 1920, U. of Ill. Herb.; Webb City, *Palmer* 18180, July 2, 1920, P. Herb.

NORTH CAROLINA

Eastern North Carolina, *McCarthy*, July, 1885, U. S. N. Herb. No. 153586; Spray, *De Chalmont*, date not given, U. S. N. Herb. No. 366864; Wilmington, *Chase* 7238, June 5-7, 1916, U. S. N. Herb. No. 1020414.

SOUTH CAROLINA

Florence, *Ball* 586, August, 1900, U. of Minn. Herb.

NEBRASKA

Nemaha, *Bates* 149, July 5, 1910, U. of Minn. Herb.

GEORGIA

Hawkinsville, *Harper* 1384, June 27, 1902, U. S. N. Herb No. 431687.

ALABAMA

Nesheka, *Carver* 9, July 10, 1897, U. S. N. Herb, No. 1020421.

FLORIDA

Cedar Keys, *Tracy* 7774, June 2, 1901, U. of Minn. Herb.; Santa Rosa Island, *Tracy* 8597, May 29, 1903, U. of Minn. Herb.

LOUISIANA

Arcadia, *Ball* 84, August 11, 1898, U. S. N. Herb. No. 1020427.

ARKANSAS

Benton County, *Plank* 101, date not given, U. S. N. Herb. No. 1020424.

OKLAHOMA

Guthrie, *Stevens* 3269, June 14, 1914, U. of Ill. Herb.; Page, *Stevens* 1467, June 20, 1914, U. of Ill. Herb.

TEXAS

Ennis, *Smith*, July, 1898, U. S. N. Herb. No. 1020455; No locality given, *Thurow*, date not given, U. S. N. Herb. No. 1020451; San Antonio, *Wilkinson* 76, month not given, 1897, M. Herb.

2c. ELYMUS VIRGINICUS JEJUNUS (Ramaley) Bush.

REFERENCES:

ELYMUS VIRGINICUS JEJUNUS (Ramaley) Bush.

E. virginicus forma *jejuna* Ramaley, Bull, Geol. and Nat. Hist. Surv. Minn. 9: 114 (1894). *E. jejuna* (Ramaley) Rydberg, Bull. Torr. Club 36: 114 (1909).

TYPE LOCALITY: Lake Benton, Minnesota.

Minnesota and North Dakota to Nebraska, Nash, 1 c. 291, 1913. This form was considered a good species by Rydberg and accepted by Nash, almost entirely on the exserted spikes and the narrow, close upper sheaths, which distinguishes it from the ordinary forms of *E. virginicus*, the spikes in that species usually being partly or wholly included in the broad inflated upper sheaths. The spikes of this variety are shorter, thicker, stiffer, and the spikelets more spreading, the glumes and lemmas longer awned, and the whole plant is more strict than is *E. virginicus*. There are, however, many plants that are intermediate between this variety and *E. virginicus*, and in my opinion it is better to consider it only a variety of that species.

SPECIMENS EXAMINED:

INDIANA

Pine, *Umbach*, June 29, 1898, D. Herb.

ILLINOIS

Laura, *Chase* 1825, July 5, 1908, U. of Ill. Herb.

MISSOURI

Carl Junction, *Palmer* 3024, July 22, 1910, U. S. N. Herb. No. 671763; Courtney, *Bush* 790, June 28, 1896, M. Herb.; Courtney, *Bush* 8443, June 29, 1918, U. of Ill. Herb.; Courtney, *Bush* 8518, July 16, 1918, U. of Ill. Herb.; Courtney, *Bush* 913, August 12, 1920, U. of Ill. Herb.; Courtney, *Bush* 9379, July 4, 1921, U. of Ill. Herb.; Lee Summit, *Mackenzie*, July 6, 1900, M. Herb.; Oronogo, *Palmer* 18774, August 22 1920, P. Herb.; Sheffield, *Mackenzie* 247, July 17, 1898, F. M. of N. M. Herb.; Sheffield, *Mackenzie* 247, July 17, 1898, M. Herb.; Webb City, *Bush* 9072, August 7, 1920, U. of Ill. Herb.; Webb City, *Bush* 9075, August 7, 1920, U. of Ill. Herb.

MINNESOTA

Lake Benton, *Sheldon* 1375, August, 1891, type of *Elymus virginicus* forma *jejuna* Ramaley, U. of Minn. Herb.; Saint Louis River, *Arthur, Bailey* and *Holway* 265, July 23, 1886, U. of Minn, Herb.

KANSAS

Quindaro, *Mackenzie*, June 21, 1896, M. Herb.

NEBRASKA

Beatrice, *Bates*, July 9, 1900, U. of Minn. Herb.; Valentine, *Bates*, August 16, 1912, U. of Minn. Herb.

NORTH DAKOTA

Lake Ibsen, *Lunell*, August 15, 1906, M. Herb.

OKLAHOMA

Caddo, *Stevens* 949, June 15, 1913, U. of Minn. Herb.; Ingersoll, *Stevens* 1778, August 1, 1913, U. of Minn. Herb.; Lamont, *Stevens* 1805, August 2, 1913, U. of Minn. Herb.

TEXAS

No locality given, *Nealley*, no month given, 1896, U. of Minn. Herb.

2D. ELYMUS VIRGINICUS SUBMUTICUS Hook. Fl. Bor. Am. 2: 255, 1840.

REFERENCES:

ELYMUS VIRGINICUS SUBMUTICUS Hook. Fl. Bov.Am.*2*:255, (1840); Hitchcock. A. Gray, Manual, 169 (1908); Wiegand, Rhodora *20:* 84 (1918). *E. curvatus* Piper, Bull. Torr. Club *30*: 233 (1903).

TYPE LOCALITY: North America.

Ohio to Minnesota, Kansas and westward, Hitchcock, 1 c. 169, 1908.

Saskatchewan to Iowa, Missouri and Kansas, Nash, 1 c. 290, 1913.

Quebec and the coast of Massachusetts, to Ililnois, Saskatchewan, Oklahoma and Washington, Wiegand, 1 c. 84, 1918.

Some specimens of this variety differ very much in aspect from *E. virginicus,* the only species in this region with which it could have any affinity, but there occur so many specimens with spikes that have now and then one or two, and sometimes several spikelets with long-awned glumes and lemmas. The presence of these long-awned glumes and lemmas in the spikes has convinced me that Hooker was right in making this a variety of *E. virginicus,* and I am not sure that it deserves even this rank.

SPECIMENS EXAMINED:

QUEBEC

Dartmouth River, *Collins, Fernald* and *Pease,* August 26 and 27, 1904, U. of Minn. Herb.

CANADA

Ottawa, *Rolland* 6091, August 30, 1917, D. Herb.

ILLINOIS

Mascoutah, *Welsch,* 1862-1871, U. of Ill. Herb.; Shepherd, *Davis* 3921, July 23, 1913, U. of Ill. Herb.; Shepherd, *Davis,* August 24, 1916, U. of Ill. Herb.

MISSOURI

Allentown, *Letterman,* July 20, 1882, U. S. N. Herb. No. 986185; Courtney, *Bush* 13, August 7, 1892, U. S. N. Herb.

No. 1020487; this specimen was sent to Vasey for determination under the number 13, and as from Courtney, Missouri, but the specimens were part of No. 802, collected near Sheffield, Missouri. Dr. Vasey reported this to me as a *Hordeum*, species not determined, and as it was collected in the railroad yards near Sheffield, Missouri, where there was no native species, this plant was undoubtedly introduced, probably from Europe; the glumes and lemmas of the spikes of this specimen are very hirsute, and it is very doubtful if this is an *Elymus* species, although it is labeled *E. virginicus submuticus* by Hitchcock; Courtney, *Bush* 761, July 2, 1896, U. S. N. Herb. No. 282381, strongly approaching *E. virginicus;* Courtney, *Bush* 7763, July 28, 1916, M. Herb.; Courtney *Bush* 8617, July 16, 1918, M. Herb.; Courtney, *Bush* 9380, July 4, 1921, U. of Ill. Herb.; Eton, *Bush* 7750, July 24, 1916, M. Herb.; Sheffield, *Bush* 802, August 7, 1892, U. S. N. Herb. No. 208086; this is the same collection as No. 13 sent to Vasey, and erroneously labeled Coourtney, Missouri.

MINNESOTA

Crookston, *Skinner* and *MacMillan* 235, August, 1900, U. of Minn. Herb.; Fergus Falls, *Sheldon* 3690, August, 1892, U. of Minn. Herb.; Red Wing, *Sandberg*, August, 1885, U. of Minn. Herb.; Saint Vincent, *Ballard* 2629, August, 1900, U. of Minn. Herb.

KANSAS

Lawrence, *Stevens* 50, August, 1891, U. of Ill. Herb.; Lawrence, *Stevens* 50, August, 1891, U. of Minn. Herb.

NEBRASKA

Grand Falls, *Bates*, September 16, 1912, U. of Minn. Herb.; Nemaha, *W. H.*, August 9, 1910, U. of Minn. Herb.

NORTH DAKOTA

Minot, *Lunell*, September 11, 1902, D. Herb.; Minot, *Lunell*, September 11, 1902, U. of Ill. Herb.; Minot, *Lunell* 182, August 20, 1905, D. Herb.; Minot, *Lunell* 182, August 20, 1905, M. Herb.; Minot, *Lunell* 182, August 20, 1905, U. of Ill. Herb.

3. ELYMUS AUSTRALIS Scrib. & Ball, Bull. Div. Agrost, 24: 46, 1901.

TYPE LOCALITY: Biltmore, North Carolina.

North Carolina to Florida, west to Arkansas and Missouri, Nash. 1. c. 292, 1913.

Connecticut to Missouri and southward, Hitchcock, 1. c. 169, 1908.

Connecticut to Missouri, south to Florida and Arkansas, Nash, 1. c. 292, 1913.

Massachusetts to Georgia, Missouri and Nebraska, Wiegand, 1. c. 84, 1919.

There seems to be some obscurity about this species that I have been unable to clear up. The type-specimens are *Biltmore Herbarium* 511b, Biltmore, North Carolina, July 7, 1897. I have seen and examined a sheet and number of this collection in the Mackenzie Herbarium which I take to be a co-type or duplicate of the type. On this sheet is a fine plant that does not at all agree with the description of *Elymus australis*, nor does it agree with specimens collected in Missouri and referred to *E. australis*. The narrow straight glumes of this Mackenzie specimen, striated at the base, seem to suggest *E. glaucifolius*, while the wide dark green hairy leaves and softly long-hairy culms seem to point to *E. striatus* and it is my opinion that this specimen of the Mackenzie Herbarium is *E. glaucifolius striatus*. The habitat "swampy woods and stream-banks," given as the habitat of *E. australis* by Wiegand[5], does not agree with the habitat of the species of Missouri, which is rocky hills and banks and dry rocky places on prairies.

SPECIMENS EXAMINED:

INDIANA

Aurora, *Deam* 16040, June 17, 1915, D. Herb.; Romona, *Deam* 8933, June 25, 1911, D. Herb.

[5] Wiegand, 1. c. 84. 1918.

MISSOURI

Alba, *Palmer* 18790, August 23, 1920, P. Herb.; Branson, *Palmer* 19262, September 20, 1920, P. Herb.; Columbia, *Hitchcock*, month not given, 1903, U. S. N. Herb. No. 731061; Eagle Rock, *Bush* 3149, August 7, 1905, M. Herb.; Graydon Springs, *Standley* 9889, September 7, 1912, U. S. N. Herb. No. 688788; Grenwood, *Bush* 9815, June 23, 1922, U. of Ill. Herb.; Joplin, *Palmer* 18429, July 19, 1920, P. Herb.; Joplin, *Palmer* 19740, August 17, 1920, R. Herb.; Neck City, *Palmer* 15666, July 19, 1919, P. Herb.; Oronogo, *Palmer* 18775, August 22, 1920, P. Herb.; Oronogo, *Palmer* 18862, August 29, 1920, P. Herb.; Saint Louis, *Eggert* 193, July 14, 1879, U. S. N. Herb. No. 1020532; Swope Park, *Bush* 9463, July 22, 1921; Webb City, *Palmer* 18767, August 22, 1920, P. Herb.; Webb City, *Palmer* 19020, September 8, 1920, P. Herb.[6]

GEORGIA

Lula Falls, *Ruth* 16, July, 1898, U. S. N., Herb.; No. 1020525; Thompson's Mills, *Allard*, June 10, 1908, U. S. N. Herb. No. 1020522.

ARKANSAS

Batesville, *Coville*, August 2, 1887, U. S. N. Herb. No. 1020537; Benton County, *Plank* 71, date not given, U. S. N. Herb. No. 1020528; Fayetteville, *Hitchcock* 16092, August 2, 1918, U. S. N. No. 1020528; Fayetteville, *Hitchcock* 16092, August 3, 1918, U. S. N. Herb. No. 1037505.

---

[6] Some specimens collected by Davis in northern Missouri were named *E. riparius* by Hitchcock, but evidently erroneously, as no other collection of this species has been seen by me from anywhere near Missouri.

I cite the following specimens which I take to be real *riparius:*

WEST VIRGINIA: White Sulphur Springs, *Mackenzie* 450, September 4, 1903, M. Herb.; White Sulphur Springs, *Mackenzie* 450, September 4, 1903, D. Herb.

NEW YORK: Pitcairn, *Phelps* 132, August 1, 1914, U. S. N. Herb. No. 907724.

CONNECTICUT: Southington, *Bissell*, August 13, 1902, D. Herb.

OKLAHOMA

Ottawa, *Stevens* 2507, August 29, 1913, U. of Minn. Herb.

4. ELYMUS STRIATUS Willd. Sp. Bl. 1: 470. 1797.

REFERENCES:

ELYMUS STRIATUS Willd. Sp. Pl. 1.470, 1797; Bush, Flora of Jackson County, Missouri, 581 (1882); Tracy, Flora of Missouri, 1731 (1886); Eggert, Catalogue of Plants of Saint Louis, Missouri, 8 (1891); Dewey; Coulter, Manual of the Plants of Western Texas *3*: 550 (1894); Mackenzie and Bush, Manual of the Flora of Jackson County, Missouri, 38 (1902); Daniels, Flora of Columbia, Missouri, 140 (1907); A. Gray Man. ed 7, 169 (1908); Nash; Britton, Man. 156 (1905); Nash Small, Flora S.E.U.S. 160 (1913) Nash; Britton & Brown, Ill. Flora 1: 293 (1913); Wiegand, Rhodora *20:* 86 (1918). E. *striatus villosus* A. Gray, Man. ed 5,639 (1867); Bush, Flora of Jackson County, Missouri, 582 (112); Dewey; Coulter, Manual of the plants of Western Texas 3: 550 (1894) Tracy, Flora of Missouri 1732, (1886); Daniels, Flora of Columbia, Missouri, 141 (1907). *E. striatus Ballii* Pammell, Ia. Geol. Surv. Suppl. Ref. *1903*: 347 (1904).

TYPE LOCALITY: America Boreali.

Maine and Ontario to Tennessee, Nebraska and Kansas, Nash, 1. c. 156. 1905.

Maine to South Dakota, southward to New Jersey and Arkansas, Hitchcock, 1. c. 179. 1908.

Main to North Dakota, North Carolina and Texas, Nash, 1. c. 193. 1913.

Maine and Ontario to Tennessee, Nebraska and Kansas, Nash, 1. c. 160. 1913.

Vermont, Massachusetts, Delaware, North Carolina, westward to Wisconsin, Kansas and Oklahoma, Wiegand, L. c. 87. 1918.

A very common species in Missouri, being found throughout the State in all kinds of ground, and presenting a very wide range of forms, but is easily distinguished from all the other species by the very narrow, subulate, aristate glumes.

SPECIMENS EXAMINED:

NEW JERSEY

Holly Beach, *Chase* 3497, July 25, 1906, U. of Ill. Herb.

PENNSYLVANIA

Bucks County, *Ruth*, July 15, 1887, U. of Minn. Herb.

DISTRICT OF COLUMBIA

High Island, *Holm*, August 5, 1913, U. of Ill. Herb.; Washington, *Steele*, July 4, 1896, U. of Minn. Herb.

OHIO

Cincinnati, *Lloyd*, July 30, 1886, U. of Minn. Herb.

INDIANA

Anderson, *Deam* 2461, August 11, 1907, D. Herb.; Battle Ground, *Deam* 17727, July 20, 1915, D. Herb.; Blackford County, *Deam*, June 25, 1905, D. Herb.; Bluffton, *Deam*, July 26, 1998, M. Herb.; Cannelton, *Deam* 28532, July 23, 1919, D. Herb.; Decker, *Deam* 17023, July 8, 1915, D. Herb.; Franklin, *Deam* 7025, July 9, 1910, D. Herb.; Franklin County, *Deam*, August 23, 1903, D. Herb.; Great Falls, *Chase* 3785 1-2, July 13, 1907, U. of Ill. Herb.; Hebron, *Deam* 32223, August 23, 1920, D. Herb.; Kosciusko, *Deam*, July 12, 1898, D. Herb.; Lowell, *Deam* 3162,July 1920, *D. Herb.*; Lyons, *Deam* 25654, July 3, 1918, D. Herb.; Manville, *Deam* 16209, June 20, 1915, D. Herb.; Milltown, *Deam* 16410, June 25, 1995, D. Herb.; Mitchell, *Deam* 17235, July 12, 1915, D. Herb.; Mooresville, *Deam* 13661, D. Herb.; New Amsterdam, *Deam* 20495, June 25, 1916, D. Herb.; Patoka, *Deam* 16882, July 6, 1915, D. Herb.; Poseyville, *Deam* 16851, July 5, 1915, D. Herb.; Princeton, *Deam* 25540, June 30, 1918, D. Herb.; Red Key, *Deam* 15432, September 13, 1924, D. Herb.; Turkey Run Park, *Deam* 32851, September 17, 1920, D. Herb.; Vevay, *Deam* 13833, July 25, 1913, D. Herb.; Wabash County, *Deam* 2236, July 7, 1906, D. Herb.; Washington, *Deam* 25616, July 2, 1918, D. Herb.; Wells County, *Deam*, August 3, 1902, D. Herb.; Wells County, *Deam*, August 3, 1912, M. Herb.; Williamsport, *Deam* 11900, August 1, 1912, D. Herb.; Yankeetown, *Deam* 25317, June 11, 1918, D. Herb.

ILLINOIS

Algonquin, *Nason,* July 10, U. of Ill. Herb.; Mahomet, *Seymour,* July 31, 1884, U. of Ill. Herb.; Mascoutah, *Welsch,* 1862-1871, U. of Ill. Herb.; Mount Carmel, *Schneck,* June, 1862-'71, U. of Ill. Herb.; Mount Carmel, *Schneck,* June, 1877, U. of Ill. Herb.; Mount Carmel, *Schneck,* July 1, 1879, U. of Ill. Herb.; No locality given, *Vasey,* date not given, U. of Ill. Herb.; No locality given, *Schneck,* date not given, U. of Ill. Herb.; No locality given, *Welsch,* date not given, U. of Ill. Herb.; Peoria, *Brendel,* date not given, U. of Ill. Herb.; Peoria, *McDonald,* August, 1890, U. of Ill. Herb.; Peoria *McDonald,* August, 1900, U. of Ill. Herb.; Peoria, *McDonald* 50 1-2, July, 1904, U. of Ill. Herb.; Peoria, *McDonald* Taylorville, Andrews, July 5, 1898, U. of Ill. Herb.; Taylorville, *Andrews,* June 29, 1899, U. of Ill. Herb.; Urbana, *Gibbs,* October 6, 1898, U. of Ill. Herb.; Wady Petra, *Chase* 128, July 22, 1989, U. of Ill. Herb.; Wady Petra, *Chase* 1236, U. of Ill. Herb.; Wady Petra, *Chase* 1507, July 14, 1907, U. of Ill. Herb.; Wabash County, *Schneck,* June 13, 1879, U. of Ill. Herb.; Wabash County, *Schneck,* June, 1900, U. of Ill. Herb.; Wabash County, *Schneck,* June 19, 1900, U. of Ill. Herb.; Wabash County, *Schneck,* July, 1900, U. of Ill. Herb.; Wabash County, *Schneck,* July 27, 1900, U. of Ill Herb.; Wabash County, *Schneck,* June 29, 1904, U. of Ill. Herb.; Wheatland, *Umbach,* July 19, 1897.

MISSOURI

Allenton, *Letterman,* July 1, 1894, F. M. oof N. M. Herb.; No. 461502; Allenton, *Letterman,* July 1, 1894, U.S.N. Herb. No. 986182; Atherton *Bush* 1760, August 1, 1902, U.S.N. Herb. No. 440205; Atherton, *Mackenzie* 83, August 1, 1902, Atherton, *Mackenzie* 83, August 1, 1902, M. Herb. Columbia, *Hitchcock,* month not given, 1902, U.S.N. Herb. No. 731036; Columbia, *Hitchcock,* date not given, U.S.N. Herb. No. 731265; Courtney, *Bush* 55, June 25, 1892, U.S.N. Herb. No. 1019731; Courtney *Bush* 801, July 11, 1896, U. of Ill. Herb.; Courtney, *Bush* 801, July 11, 1896, U.S.N. Herb. No. 2832775; Courtney, *Bush* 9374, June 29, 1921, U. of Ill.

Herb.; Creve Coeur Lake, *Hitchcock*, month not given, 1894, U.S.N. Herb. No. 731264; Floyd *Bush* 9402, July 11, 1921, U. of Ill. Herb.; Martin City, *Mackenzie* 49, July 25, 1902, D. Herb.; Martin City, *Mackenzie* 49, July 25, 1902, M. Herb.; Neck City, *Palmer* 18128, July 1, 1920, P. Herb.; Oakwood, *Davis* 1216, April 4, 1911, U.S.N. Herb. No. 674012; Saint Louis, *Eggert*, July 7, 1875, U.S.N. Herb. No. 1019732; Waldo Park, *Mackenzie*, July 26, 1896, F.M. of N.M. Herb. No. 431339; Watson, *Palmer* 18942, September 3, 1920, P. Herb.

NORTH CAROLINA

Biltmore, *Biltmore Herbarium* 410-b, July 2, 1897, U. of Minn. Herb.

MICHIGAN

Grand Ledge, collector not given, July 26, U. of Minn. Herb.; Grand Rapids, *Fallas*, July 8, 1897, U. of Minn. Herb.

IOWA

Adair County, *Stewart*, July 2, 1892, U. of Minn. Herb.; Ames, *Stewart*, July 15, 1892, U. of Minn. Herb.; Battle Creek, *Preston* 95%, July 16, 1897, M. Herb.; Muscatine, *Mackenzie* 779, month not given, 1894, M. Herb.

MINNESOTA

Grand Lake, *Campbell* 129, July, 1896, U. of Minn. Herb.; Hennepin County, *Aiton*, August, 1889, U. of Minn. Herb.; Luverne, *Wheeler* 1067, September 10, 1901, U. of Minn. Herb.; Swan Lake, *Ballard*, 1005, July, 1862, U. of Minn. Herb.; Swan Lake, *Ballard*, 1005, July, 1892, U. of Minn. Herb.

KANSAS

Quindaro, *Mackenzie*, June 21, 1896, M. Herb.; Quidaro, *Mackenzie*, June 21, 1896, U. of Minn. Herb.

NEBRASKA

Thomas County, *Tulen*, May 5, 1893, U. of Minn. Herb.

SOUTH DAKOTA

Deadwood, *Williams*, July 1, 1892, U. of Minn. Herb.

NORTH DAKOTA

Devil's Lake, *Lunell*, August 10, 1910, D. Herb.; Devil's Lake. *Lunell* 857, August 19, 1910, U. of Ill. Herb.

OKLAHOMA

Tonkawa, *Stevens* 1896 1-2, U. of Minn., Herb.; Tonkawa, *Stevens* 1895 1-2, U. of Minn. Herb.

TEXAS

San Antonio, *Wilkinson* 75, month not given, 1897, M. Herb.

5. ELYMUS ARKANSANUS Scribn. & Ball, Bull. Div. Agrost. 24: 45. 1901.

REFERENCES:

ELYMUS ARKANSANUS Scribn. & Ball. Bull. Div. Agrost. 24: 45. 1901; Nash, Britton, Manual, 1053 (90); Nash, Britton & Brown, Ill. Flora 1: 294 (1913). *E. striatus arkansanus* (Scribn. & Ball) Hitchc. Rhodora 8: 212. (1900); Hitchcock, A. Gray, Manual, 16, (1908); Wiegand, Rhodora 20: 87 (1918).

TYPE LOCALITY: Woods of northwestern Arkansas.

Iowa to Arkansas and Missouri, Nash, 1. c. 1053. 1905.

Maryland, Iowa and southward, Hitchcock, 1. c. 169. 1908.

New Jersey and Staten Island to Iowa, and Arkansas, Nash, 1. c. 294. 1913.

Iowa, Missouri, Arkansas, Nebraska, Virginia and Illinois, Wiegand, 1. c. 87. 1918.

Generally confused with *E. striatus* by collectors, but seems to have longer and wider glumes and lemmas, which are usually quite glabrous, rarely a little scabrous. I am retaining this plant as a species mainly because it appears to occupy a distinct area of its own.

SPECIMENS EXAMINED:

NEW JERSEY

Millburn. *Mackenzie* 584, September 20, 1903, D. Herb.

VIRGINIA

Bedford County, *Curtis*, July, 1871, U. of Ill. Herb.

INDIANA

Kosciusko County, *Deam*, July 12, 1898, D. Herb.

ILLINOIS

Peoria, *Brendel*, date not given, U. of Ill. Herb; Stark County, *Chase*, date not given, U. of Ill., Herb.; Wady Petra, *Chase*, June 25. 1897, U. of Ill. Herb.

MISSOURI

Forest Mill, *Palmer* 18365, July 15, 1920, P. Herb.; Medill, *Bush* 9175, August 24, 1920, U. of Ill. Herb.; Nocl. *Palmer* 1905, September 10, 1920, P. Herb.; Springfield, *Hoover*, month not given, 1897, U. of Ill. Herb.; Springfield, *Hoover*, month not given, 1897, U.S.N. Herb. No. 1019445 Springfield, *Standley* 8537, August 31, 1911, U.S.N. Herb. No. 687488.

MINNESOTA

Sleepy Eye, *Sheldon* 842, July, 1891, U. of Minn. Herb.; Sleepy Eye, *Sheldon* 976 1-2, July, 1891, U. of Minn. Herb.

SOUTH DAKOTA

Elk Point, *Wallace*, August, 1892, U. of Minn. Herb.

NORTH DAKOTA

Lake Ibsen, *Lunell*, July 26, 1915, D. Herb.; Lake Ibsen, *Lunell*, July 26, 1915, U. of Ill. Herb.

TEXAS

San Antonio, *Heller* 1712, May 5, 1894, U. of Ill. Herb.; San Antonia, Heller 1712, U. of Minn. Herb.; Southern Texas, *Lindheimer*, 1849-51, M. Herb.

San Antonio, *Heller*, 1712, U. of Minn. Herb.; Southern 131. 1809.

6. ELYMUS GLAUCIFOLIUS Muhl. in Willd. Enum. Hort Berol, 131, 1809.

REFERENCES:

ELYMUS GLAUCIFOLIUS Muhl. in Willd. Enum. Hort. Berol. 131 (1809); Daniels, Flora of Columbia, Missouri, 100 (1907).

E. canadensis glaucifolius (Muhl.) Torr. Fl. U.S. *1:* 137 (1824); Bush, Flora of Jackson County, Missouri, Suppl. 902 (1885); Tracy, Flora of Missouri, 1729, (1886) Eggert, Catalogue of Plants of Saint Louis, Missouri, 8 (1891); Mackenzie and Bush, Manual of the Flora of Jackson County, Missouri, 38 (1902); Hitchcock, A. Gray, Man. 169 (1908). *E. canadensis* L., Bush., Flora of Jackson County, Missouri, 579, (1882); Tracy, Flora of Missouri, 1728, (1886); Eggert, Catalogue of Plants of Saint Louis, Missouri, 8 (1891); Dewey; Coulter, Manual of Plants of Western Texas *3*: 550 (1894); Mackenzie and Bush, Manual of the Flora of Jackson County, Missouri, 38 (1902); Nash, Britton, Manual 157 (1905), in large part; Daniels, Flora of Columbia, Missouri, 100 (1907), in large part; Hitchcock, A. Gray, Manual, 169 (1908), in large part; Nash, Britton & Brown, Ill. Flora, ed 2. *1:* 293 (1913); Nash, Small, Flora of the S.E.U.S. ed 2. 160 (1913), in large part; Palmer, Flora of Jasper County, Missouri, 365 (1916) in part. "*E. robustus* S. &. S." Wiegand, Rhodora 20: 89 (1918) in large part.

TYPE LOCALITY: Pennsylvania.

There is no doubt in my mind that Muhlenberg's species is distinct from the *E. canadensis* of Linnaeus, and Wiegand has shown this to be so in his paper where he says "although it (*E. glaucifolius*) came from Pennsylvania from which State we have seen no specimens of *E. canadensis*."[1] If Wiegand had only stopped to consider a moment, he would have seen that Muhlenberg's species could not be *E. canadensis* L., for the very reason that the range of that species does not extend to Philadelphia, the place where Muhlenberg collected his species. *E. glaucifolius* came from Pennsylvania, probably from near Philadelphia or Germantown, and Wiegand says it is *E. canadensis*, and then says *E. canadensis* does not occur in Pennsylvania, which seems rather paradoxical to me.

Wiegand further erred in referring the remainder of the eastern plants that had formerly been referred to *E. canadensis*, to *E. robustus*, a species of the interior prairie region,

[1] Wiegand, l. c. 89. 1918.

not realizing that he had in hand two forms of one species.

In a species that is immensely variable, and so very widely distributed, it is only natural that there should be many forms, and that these forms would be taken by some writers for species, and by other writers as varieties. The two varieties that I have here recognized, of this species, I do not feel sure are more than mere forms, but I am sure they are the same forms that have been described by the writers whom I quote as authors of the names here used.

SPECIMENS EXAMINED:

NEW YORK

Ithaca, *Pearce*, October 6, 1883, U.S.N. Herb. No. 153581.

CANADA

Lethbridge, *Hitchcock* 4963, September 19-22, 1909, U. of Ill. Herb.; Lipton, *Clokey* 1630, August 20, 1911, M. Herb.; Ottawa, *Rolland* 35, August 14, 1915, U. of Ill. Herb.; Wies' Beach, *Morris* 178, August 14, 1902, U. of Ill. Herb.

NEW JERSEY

Highland Park, *Mackenzie* 2874, August 25, 1904, M. Herb.; Mount Arlington, *Mackenzie* 910, August 21, 1904, M. Herb.; Phillipsburg, *Mackenzie* 4288, August 15, 1909, M. Herb.

MARYLAND

Beltsville, *Chase* 3834, September 1, 1907, U. of Ill. Herb.; Garrett County, *Smith*, August, 1879, U.S.N. Herb. No. 821762.

DISTRICT OF COLUMBIA

Bennings, *Steele*, June 24, 1902, U. of Ill. Herb.

VIRGINIA

Portsmouth, *Noyes* 37, month not given, 1895, U.S.N. Herb. No. 1020409. This specimen is cited by Scribner and Ball as *E. glabriflorus* in their paper,[5] but the specimen apparently belongs to the *virginicus* group. Perhaps Scribner

[5] Scribner and Ball, l. c. 49. 1911.

and Ball were misled by some of Vasey's specimens of *E. robustus*, which he included in his description of *E. canadensis glabriflorus*.

INDIANA

Blue Bluffs, *Deam* 2532, August 18, 1907, D. Herb.; Blue Bluffs, *Deam* 2532, August 18, 1907, D. Herb.; Blue Bluffs, *Deam* 2693, September 22, 1907, D. Herb.; Cedar Lake *Deam* 14618, August 24, 1914, D. Herb.; Cedar Point, *Deam*, July 12, 1903, D. Herb.; Chesterton, *Deam* 18049, August 22, 1915, Herb.; Cicott, *Deam* 32160, August 21, 1920, D. Herb.; Culver, *Deam* 2102L, August 21, 1916, D. Herb.; Culver *Deam* 21020 August 21, 1916, D. Herb.; Delphi, *Deam* 17789, July 22, 1915, D. Herb.; Fowler, *Deam* 11833, July 31, 1912, D. Herb.; Fowler, *Deam* 32726, September 15, 1920, D. Herb.; Franklin County, *Deam*, August 23, 1903, D. Herb.; Goldsmith, *Deam* 13900, August 2, 1913, D. Herb.; Goldsmith, *Deam* 13900, August 2, 1913, D. Herb.; Indiana Harbor, *Deam* 2408, July 28, 1907, D. Herb.; Hillsdale, *Deam* 9798, September 27, 1911, D. Herb.; Hog Back Lake, *Deam* 1261, July 23, 1906, D. Herb.; Moy Back Lake, *Deam* 32522, August 29, 1920, D. Herb.; Indianapolis, *Deam* 14092, August 24, 1913, D. Herb.; James Lake, *Deam* 15502, September 20, 1903, D. Herb.; Lake Cicott, *Deam* 32619, September 14, 1920, D. Herb.; Michigan City, *Deam* 5222, August 16 1908, D. Herb.; Monroe County, *Deam* 12356, September 8, 1912, D. Herb.; Pretty Lake, *Deam* 14886, August 27, 1914, D. Herb.; Rainesville, *Deam* 21588, August 31, 1916, D. Herb.; Remington, *Deam* 11799, July 30, 1912, D. Herb.; Roby, *Sherff* 1694, August 17, 1912, U. of Ill. Herb.; Russellville, *Deam* 7407, August 28, 1910, D. Herb.; Sullivan County, *Deam* 29319, August 21, 1919, D. Herb.; Thayer, *Deam* 21488, August 30, 1916, D. Herb.; Turkey Run, *Deam* 9891, September 2, 1911, D. Herb.; Wells County, *Deam*, September 1, 1904, D. Herb.; Wells County, *Deam*, September, 1904, D. Herb.; Whitley County, *Deam* 14618, August 24, 1914, D. Herb.

ILLINOIS

Canton, Collector and date not given, U. of Ill, Herb.;

Champaign, *Waite*, July 12, 1886, U. of Ill. Herb.; Chicago, *Lansing* 370, July 21, 1898, U. of Minn. Herb.; Ferris, *Gates* 10793, September 1, 1917, U. of Ill. Herb.; Joe Davies County, *Pepoon* 190, August 15, 1908, U. of Ill. Herb.; Mascoutah, *Welsch*, 1862-1871, U. of Ill. Herb.; no locality given, *Chase* 81, August 10, 1897, U. of Ill. Herb.; no locality given, *Chase*, date not given, U. of Ill. Herb.; no locality given, *Brendel*, date not given, U. of Ill. Herb.; Peoria, *Brendel*, date not given, U. of Ill. Herb.; Peoria, *McDonald*, July, 1896, U. of Ill. Herb.; Taylorville, *Andrews*, July 27, 1898, U. of Ill. Herb.; Taylorville, *Andrews*, June 21, 1899. U. of Ill. Herb.; Wabash County, *Schneck*, July 26, 1904, U. of Ill. Herb.; Wady Petra, *Chase* 1235, August 7, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1238, August 12, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1239 1-2, August 12, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1241, August 12, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1243, August 12, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1244, August 19, 1906, U. of Ill. Herb.; Wady Petra, *Chase* 1550, August 17, 1907, U. of Ill, Herb.; Warren, *Pepoon* 74, August 1, 1908, U. of Ill. Herb.; Waukegan, *Gates* 2879, month not given, 1908, U. of Ill. Herb.; Waukegan, *Gates* 2880, month not given, 1907, U. of Ill. Herb.; Waukegan, *Gleason* and *Shobe* 327, August 16, 1906, U. of Ill. Herb.

MISSOURI

Allenton, *Letterman*, date not given, U.S.N. Herb. No 986183; Allenton, *Letterman*, June, 1880, U.S.N., Herb. No. 986181; Allenton, *Letterman*, July 25, 1884, U.S.N. Herb. No. 986180; Carterville, *Palmer* 18243A, July 2, 1919, P. Herb.; Clarksville, *Davis* 1133A, September 24, 1911, U.S.N. Herb. No. 673409; Courtney, *Bush* 780, July 9, 1895, U.S.N. Herb. No. 673988; Courtney, *Bush* 708, July 9, 1896, U. of Ill. Herb.; Courtney, *Bush* 766, July 17, 1896, U.S.N. Herb. No. 282382; Courtney, *Bush* 814, July 31, 1900, U.S.N. Herb. No. 386725; Courtney, *Bush* 816, August 1, 1900, U.S.N. Herb. No. 286724; Courtney, *Bush* 816, August 1, 1900, U.S.N. Herb. No. 386726; Courtney, *Bush* 6006, July 15, 1910, U.S.N. Herb. No. 671725; Courtney, *Bush* 7735,

July 14, 1915, U. of Ill. Herb.; Courtney, *Bush* 9097, August 12, 1920, U. of Ill. Herb.; Dodson, *Mackenzie*, July 26, 1896, M. Herb.; Eolia, *Davis* 8727, July 23, 1916, U. of Ill. Herb.; Glencoe, *Letterman*, August, 1883, U.S.N. Herb. No. 986179; Grandview, *Mackenzie* 114, August 5, 1902, M. Herb.; Hannibal, *Davis* 103, September 16, 1900, U.S.N. Herb. No. 67935; Hannibal, *Davis* 1105, September 19, 111, U.S.N. Herb. No. 673963; Hannibal, *Davis* Acl., July 16, 1913, U. of Ill. Herb.; Hannibal, *Davis* 120, July 21, 1913, U. of Ill. Herb.; Henrietta, *Bush* 9142, August 23, 1920, U. of Ill. Herb.; Independence, *Mackenzie*, July 29, 1900, D. Herb.; Independence, *Mackenzie*, July 29, 1900, M. Herb.; Jefferson County, *Eggert* July 17, 1893, U.S.N. Herb. No. 1020784; Joplin *Palmer* 17608, August 7, 1920, P. Herb.; Lees Summit, *Bush*, 3091, July 25, 1905, U.S.N. Herb. No. 607672; Little Blue, *Mackenzie*, August 2, 1896, F. M. of N. H. Herb. No. 431340; Oakwood, *Davis* 1313, October 5, 1900, U.S.N. Herb. No. 674011; Pacific, *Eggert*, July 14, 1879, F. M. of N. H. Herb. No. 410581; Pacific, *Eggert*, July 14, 1879, U.S.N. Herb. No. 726356; Randolph, *Mackenzie* 265, July 17, 1898, M. Herb.; Randolph, *Mackenzie* 266, July 17, 1898, M. Herb.; Red Bridge, *Mackenzie* 499, September 18, 1901, M. Herb.; Red Bridge, *Mackenzie* 500, September 18, 1901, D. Herb.; Red Bridge, *Mackenzie* 500, September 18, 1901, M. Herb.; Sheffield, *Bush* 151, July 10, 1899, U.S.N. Herb. No. 392976; Sheffield, *Mackenzie*, August 29, 1897, M. Herb.; Sheffield, *Mackenzie*, July 29, 1901, M. Herb.; Sheffield, *Mackenzie* 19, July 22, 1902, M. Herb.; Sibley, *Mackenzie* 552, October 2, 1901, D. Herb.; Sibley, *Mackenzie* 552, M. Herb.; Springfield, *Standley* 9117, October 21, 1912, U.S.N. Herb. No. 688036; St. Louis, *Eggert*, July 10, 1897, U.S.N. Herb. No. 1020783; Swope Park, *Bush* 7705, July 21, 1915, U. of Ill. Herb.; Swope Park, *Bush* 7705, July 21, 1915, U. S. N. Herb. No. 837992; Swope Park, *Bush* 7716, August 6, 1915, U. of Ill. Herb.; Swope Park, *Bush* 9444, July 22, 1921, U. of Ill. Herb.; Swope Park, *Bush* 9462, July 22, 1921, U. of Ill. Herb.; Swope Park, *Mackenzie* 345, September 13, 1901, M. Herb.; Watson, *Bush* 9174, September 4, 1920, U. of Ill.

Herb.; Watson, *Bush* 9178, September 3, 1920, U. of Ill. Herb.; Watson, *Palmer* 18908, September 3, 1920, P. Hero.; Webb City, *Bush* 9078, August 8, 1920, U. of Ill. Herb.; Webb City, *Palmer* 16272, September 1, 1918, P. Herb.

IOWA

Ames, *Stewart*, month not given, 1892, U. of Minn. Herb.

WISCONSIN

Silver Lake, *Gates* and *Sleeper* 1813, July 25, 1907, U. of Ill. Herb.

MINNESOTA

Detroit, *Seymour*, August 20, 1884, U. of Ill. Herb.; Sandy Lake, *Sandberg* 770, August 10, 1891, U. of Ill. Herb.; Worthington, *Foote*, August, 1884, U. of Ill. Herb.

KANSAS

Lawrence, *Stevens* 49, August, 1891, U. of Ill. Herb.; Lawrence, *Stevens* 49, U. of Minn. Herb.

NEBRASKA

Neligh, *Bates* 5698, August 6, 1912, U. of Minn. Herb.; Redland, *Bates* 5662, August 4, 1912, U. of Minn. Herb.; Thomas County, *Rydberg* 1476, July 3, 1893, U. of Ill. Herb.; Valentine, *Bates*, August 7, 1912, U. of Minn. Herb., marked *E. canadensis villosus*, but leaves and sheaths only minutely scabrous. Probably the type of *E. canadensis villosus* Bates. Amer. Bot. 20: 17. 1914.

SOUTH DAKOTA

Hot Springs, *Rydberg* 1174, August 9, 1892, U. of Minn. Herb.

NORTH DAKOTA

Benton County, *Lunell*, July 7, 1901, M. Herb.; Butte, *Lunell*, July 22, 1904, U. of Ill. Herb.; Fargo Devil's Lake, *Lunell*, August 26, 1911, U. of Ill. Herb.; Fargo, *Lunell* 187, September 4, 1915, U. of Ill. Herb.; Leeds, *Lunell*, July 9, 1901, U. of Ill. Herb..; Leeds, *Lunell* 30, July 16, 1901, U. of Ill. Herb.; Leeds, *Lunell*, August 7, 1901, M. Herb.; Leeds, *Lunell*, August 11, 1901, M. Herb.

OKLAHOMA

Cleo *Stevens* 792, June 8, 1913, U. of Ill Herb.; Stillwater, *Bogue* 478, May 28, 1896, U. of Minn. Herb.

TEXAS

Gillespie County, *Jermy*, date not given, U. of Ill. Herb.; Hempstead, *Hall*, June, 1872, U. of Ill. Herb.; Kerrville, *Hitchcock* 5310, June 22, 1910, U. of Ill. Herb.; Weatherford, *Tracy* 8115, May 31, 1902, U. of Minn. Herb.

NEW MEXICO

Dona Ana County, *Wooton*, July 1, 1902, U. of Ill. Herb.; Mesilla, *Wooton*, 19, June 16, 1897, U. of Minn. Her.b

COLORADO

Denver, *Holm*, July 8, 1896, U. of Ill. Herb.; Starkville, *Chase* 5238, September 5-11, 1908, U. of Ill. Herb.

WYOMING

Fort McKinney, *Chase* 5263, August 23, 1908, U. of Ill. Herb.; Sundance, *Chase* 5275, August 26, 1908, U. of Ill Herb.

MONTANA

Hamilton, *Chase* 5192, August 1-2, 1908, U. of Ill. Herb.; Miles City, *Seymour*, September 3, 1884, U. of Ill Herb.; Missoula, *Sandberg* 982, September, 1892, U. of Minn. Herb.

6A. ELYMUS GLAUCIFOLIUS CRESCENDUS (Ramaley) n. comb.

REFERENCES:

ELYMUS GLAUCIFOLIUS CRESCENDUS (Ramaley) Bush. *E. canadensis* forma *crescendus* Ramaley, Bull. Geol. & Nat. Hist. Surv. Minn. 9:114. (1894). *E. crescendus* (Ramaley) Wheeler, Minn. Bot. Stud. *3:* 106 (1903). *E. robustus vestitus* Wiegand, Rhodora *20:* 90 (1918), in great part.

TYPE LOCALITY: Springfield, Minnesota.

New Brunswick and Maine to Delaware, westward to Oregon, southward in the Mississippi Valley to Missouri, and southwest to Arizona, Wiegand, l. c. 90. 1918.

Everything in Ramaley's description points to *E. glaucifolius*, and not to *E. robustus* as stated by Wiegand.* The

* Wiegand, l. c. 90. 1918.

type specimens of *E. robustus* were glabrous, but the forms of the *glaucifolius* vary from glabrous to hirsute.

This form is distinguished from the other two forms of *E. glaucifolius* by the long, very slender, drooping spikes, and usually hirsute glumes and lemmas, but this hirsute character is very variable and is sometimes entirely lacking in some specimens. The three forms here considered all agree in having the glumes and lemmas from minutely scabrous to densely hirsute, and all three agree in having leaves that are slightly to conspicuously glaucous beneath.

It is claimed by some writers that the name *crescendus* can not be used for a varietal or specific name, as it was not used by Ramaley[10] for either of these, but there can be no doubt that the name *crescendus* was firmly established by Wheeler,[11] and the type designated.

SPECIMENS EXAMINED:

NEW YORK

Chemung, *Lucy* 11936, U. of Minn. Herb.

CANADA

Edmonton, *White*, August 23, 1893,, U. of Minn. Herb.: Toronto, *White* 11938, August 5, 1892, U. of Minn. Herb.

NEW JERSEY

Phillipsburg, *Small*, August 15, 1890, U. of Minn. Herb.

DISTRICT OF COLUMBIA

Washington, *Steele*, July 29, 1896, U. of Minn. Herb.

VIRGINIA

Luray, *Steele* 189, August 28, 1901, U. of Minn. Herb.

INDIANA

Millers, *Umbach*, August 14, 1897, U. of Minn. Herb.

ILLINOIS

Du Page County, *Moffatt*, August 1, 1892, U. of Minn. Herb.

---

[10] Ramaley, l. c. 114. 1894.
[11] Wheeler, l. c. 106. 1903.

MISSOURI

Courtney, *Bush* 9468, July 27, 1921, U. of Ill. Herb.; Little Blue, *Mackenzie*, August 2, 1896, D. Herb.; Little Blue, *Mackenzie*, August 2, 1896, U. of Minn. Herb.; Swope Park, *Bush* 9465, July 22, 1921, U. of Ill. Herb.; Washington Park, *Mackenzie*, July 17, 1896, M. Herb.; Washington Park *Mackenzie*, July 17, 1896, U. of Minn. Herb.

MICHIGAN

Cheboygan County, *collector not given*, August 10, 1880, U. of Minn. Herb.; Jackson County, *Camp*, July 31, 1895, U. of Minn. Herb.; Jackson County, *Camp*, August 30, 1898. U. of Minn. Herb.

IOWA

Ames, *Stewart*, July 12, 1892, U. of Minn. Herb.

MINNESOTA

Crooked Creek, *Wheeler*, 292, July 6, 1899, U. of Minn. Herb.; Eagle Lake, *Sheldon* 3418, August, 1892, U. of Minn. Herb.; Glenwood, *Taylor*, July, 1891, U. of Minn. Herb.; Hennepin County, *Aiton*, August, 1889, U. of Minn. Herb.; Hennepin County, *Oestlund*, August 13, 1888, U. of Minn. Herb.; Hennepin, County *Sandberg*, August, 1889, U. of Minn. Herb.; Humbeldt, *Ballard*, August, 1900, U. of Minn. Herb.; Milaca, *Sheldon* 3300, July, 1892, U. of Minn. Herb.; Milaca, *Sheldon* 3300, July, 1892, U. of Minn. Herb.; Milan, *Skinner* 68, August 1900, U. of Minn. Herb.; Minneapolis, *Aiton*, August, 1891, U. of Minn. Herb.; Minneapolis, *Anderson* 946, date not given, U. of Minn. Herb.; Minneapolis, *Oestlund*, August 13, 1888, U. of Minn. Herb.; Montevideo, *Moyer*, July, 1894, U. of Minn. Herb.; Muskoda, *Ballard*, 3047, August 10, 1901, U. of Minn. Herb.; Muskoda, *Ballard* 3047, August 10, 1901, U. of Minn. Herb.; Northcote, *Ballard*, August, 1900, U. of Minn. Herb.; Oak Point, *MacMillan* and *Sheldon*, July, 1894, U. of Minn. Herb.; Pipestone City, *Menzel*, month not given, 1891, U. of Minn. Herb.; Red Wing, *Sandberg*, July, 1891, U. of Minn. Herb.; Rockville, *Campbell* 71, July, 1896, U. of Minn. Herb.; Springfield, *Sheldon* 1120, July, 1891, U. of Minn. Herb., type of *E. canadensis*

forma *crescendus* Ramaley; Waconia *Ballard* 765, July, 1891 U. of Minn, Herb.

NEBRASKA

Kennedy, *Bates*, August 1, 1913, U. of Minn. Herb.; Scott's Bluff, *Rydberg* 473, August 4, 1891, U. of Minn. Herb.; Whitney, *Bates* 6087, U. of Minn. Herb.

SOUTH DAKOTA

Deadwood, *Carr* 106, July 27, 1913, U. of Minn. Herb.

NORTH DAKOTA

Leeds, *Lunell*, July 8, 1901, U. of Minn. Herb.

MISSISSIPPI

Starkville, *Tracy*, July 18, 1892, U. of Minn. Herb.

COLORADO

Black Canon, *Baker* 695, August 1, 1901, U. of Minn. Herb.; Durango, *Baker, Earle* and *Tracy* 98L, July 18, 1898, U. of Minn. Herb.; Fort Collins, *Baker* 8778, August 23, 1894, U. of Minn. Herb.

WYOMING

Albany County, *Nelson* 7600, July 16, 1900, U. of Minn. Herb.; Fairbanks, *Nelson* 552, July 15, 1894, U. of Minn. Herb.; Fort Laramie, *Nelson* 9191, July 25, 1908, U. of Minn. Herb.

MONTANA

Gallatin, *Rydberg* 2287, July 29, 1895, U. of Minn. Herb.; Sand Coulee, *Anderson*, August, 1881, U. of Minn. Herb.

IDAHO

Shoshone, *Nelson* and *MacBride* 1189, July 19, 1911, U. of Minn. Herb.; Sweet, *MacBride* 1630, August 14, 1911, U. of Minn. Herb.

WASHINGTON

Alma, *Elmer* 518, July, 1897, U. of Minn. Herb.

6B. ELYMUS GLAUCIFOLIUS ROBUSTUS (Scribn. & Smith) n. comb.

REFERENCES:

E. GLAUCIFOLIUS ROBUSTUS (Scrib. & Smith) Bush. *E. robustus* Scribn. & Smith, Bull. Div. Agrost. *4:* 37. (1897); Nash, Britton, Manual, in large part, 157 (1905); Hitchcock, A. Gray, Manual, in large part, 169 (1908); Nash, Small, Flora, in large part, 160 (1913); Wiegand, Rhodora *20:* 89 (1918) in large part. *E canadensis L.*, Palmer, Flora of Jasper County, Missouri, in part, 365 (1916). *E. canadensis robustus* (Scribn. & Smith) Mackenzie and Bush. Manual of the Flora of Jackson County, Missouri, 38 (1902). *E. brachystachys* Scribn. & Ball, Bull. U. S. Dep. Agr. *24:* 47 (1901); Nash, Britton Manual, 2nd ed. Suppl. 1054 (1905); Hitchcock, A. Gray, Man. 7th ed. 169 (1908); Nash, Britton & Brown, Ill. Flora *1:* 2nd ed. 293 (1913); Palmer, Flora of Jasper County, Missouri, 365 (1916).

TYPE LOCALITY: Illinois, Iowa, Kansas and Montana.

Illinois, Michigan, South Dakota, Montana, Kansas to New Mexico, Texas and Mexico, Nash, l. c. 157, 1905.

Illinois to Michigan, South Dakota and Mexico, Hitchcock, l. c. 169. 1908.

Illinois to Arkansas, Montana and Kansas, Nash, l. c. 160. 1913.

Michigan, Alberta, South Dakota, Missouri, Texas and Mexico, Nash, l. c. 293. 1913.

Illinois and Michigan, to Montana, Colorado, Iowa, Missouri, Ohio, Texas, New Mexico and Arizona, Wiegand, l. c. 89. 1918.

There can be no doubt that this plant is only a form of *E. glaucifolius*, but as long as it can be distinguished in the field and the herbarium, it should be distinguished by some name, and I am therefore assigning it varietal rank under *E. glaucifolius*. Nash had already reduced this species to *E. canadensis* (i. e. *E. glaucifolius*) in the Illustrated Flora, and Wiegand in his paper included both *E. glaucifolius* and *E. robustus* under the latter name, and cites localities that proves that he had both forms in hand at the time. It may be generally distinguished from the other two forms of *E.*

glaucifolius by shorter, stouter spikes, which are thicker, and but little nodding at the apex.

SPECIMENS EXAMINED:

MISSOURI

Courtney, *Bush* 9467, September 27, 1921, U. of Ill. Herb.; Floyd, *Bush* 9399, July 11, 1921, U. of Ill. Herb.; Floyd, *Bush* 9403, July 11, 1921, U. of Ill. Herb.; Floyd *Bush* 9404, July 11, 1921, U. of Ill. Herb.; Floyd, *Bush* 9405, July 11, 1921, U. of Ill. Herb. Floyd, *Bush* 9406, July 11, 1921, U. of Ill. Herb.; Sheffield, *Bush* 9385, July 8, 1921, U. of Ill. Herb.; Sheffield, *Bush* 9389, July 8, 1921, U. of Ill. Herb.[12]

IOWA

Muscatine, *Mackenzie* 690, August 8, 1894, M. Herb.

KANSAS

Nearman, *Mackenzie*, July 7, 1897, M. Herb.; Rosedale, *Mackenzie*, July 12, 1896.

TEXAS

Dallas, *Reverchon* 1140, May 26, 1900, M. Herb.

[12] Specimens collected in northeastern Missouri by Davis, were sent to Hitchcock for identification, who determined them as *E. diversiglumis*, but I have seen no specimens from anywhere near this state that are that species, which seems to range from Wisconsin and Minnesota to North Dakota and Wyoming.

REPORT ON THE STUDY AND APPRAISAL OF MUSSEL RESOURCES IN SELECTED AREAS OF THE UPPER MISSISSIPPI RIVER, 1920-25.*

N. M. GRIER.

DARTMOUTH COLLEGE HANNOVER, N. H.

I.—INTRODUCTORY.

During the months of August and September, 1925, the U. S. Bureau of Fisheries repeated a study and appraisal of the mussel resources in certain selected areas of the Upper Mississippi River, originally made in July and August, 1920. Both investigations were carried on with reference to legislation on the part of the States of Wisconsin and Minnesota which provided for the closure of certain of these areas for the protection of the fresh water mussels during a period of five years, as well as for areas to remain subject to fishery. The data acquired in 1920 was expected to form a basis for comparing the conditions of that time with those of 1925, after a period of protection.

In 1920, the area studied began at a point about five miles above Red Wing, Minnesota, extending thence through Lake Pepin, and ending nearly 80 miles down stream at La Moille, Minn. In 1925, however, it was arranged that Mr. J. B. Southall, of the Bureau of Fisheries, undertake the bulk of the survey work in Lake Pepin, so as far as the work of the my party was concerned in 1925, the more productive areas of the lake were omitted. The regions studied by Mr. Southall are indicated in the report for 1920 as Areas IV and V. During this investigation, Messrs. R. H. Young, of the Northwestern University Medical School, and Leonard Loeding, of Lake City, Minn., served as assistants.

For a fuller account of the work of 1920 see Final Report on the Study and Appraisal of Mussel Resources in Selected Areas of the Upper Mississippi River. Amer. Mid. Naturalist, Vol. VIII, No. 1, Jan. 1922.

---

* Published by permission of the Commissioner of Fisheries, Washington, D. C.

II.—GENERAL CONDITIONS IN THE AREAS IN 1925.

While in 1920, the river at the time of investigation was in a flood stage of from 2-9 ft., the opposite conditions prevailed in 1925. Government engineers at Fountain City stated that with the exception of a lower stage noted in September, 1923, the stage during which we worked was the lowest since 1864, and varied from 3 ft. above to 3 ft. below zero* during the period between Aug. 15 to Sept. 15. The normal low water stage for the river during August and September is from 2-2½ ft. above zero.

The general effect of this condition was to cause a migration of the mussels toward the channel, which fact had to be taken into account in relocating the stations appraised in 1920. In many cases throughout the region covered by the survey, mussels large and small were observed to be dead and dying as a result of inability to move with the water as it fell. Snags were fully as abundant in the river in 1925 as in 1920. From the clammer's standpoint, the time of the survey in 1925 was not a propitious one. Their contention is that during the normal low water period of August and early September, the mussels burrow in the mud and are not easily taken with the apparatus used by our party, shortly to be described. It is true that some species of mussels burrow in the mud, but such is liable to occur at any season of the year when the substratum does not give sufficient support, and when the mussels are unable to move as the water falls. What may occur to explain the scanty returns secured by clammers in that part of the season is that the clam bed as such is fairly well clammed out by that time, and the remaining shells are so scattered as not to be readily caught under the conditions. Then, when left alone, the beds may gather other shells as they are swept in by the current or migrate from unfavorable conditions elsewhere. At Red Wing, for example, we secured fair hauls of shells from a depth of 2-4 inches of mud. At

* Inspector C. G. Weyl, U. S. Engineers, Fountain City, Wisconsin, furnishes the following information in connection. "The term zero is based on the low water stage of 1864, and the elevation of zero is 644-5 ft. above sea level."

Wabasha, our returns from crow-foot bars were very scanty, yet a young woman had collected a considerable number of shells by hand that same day in the vicinity of our drags. If the clams naturally require a rest at that period of the summer and thus are compelled to go down in the mud, this young woman, as well as our party in the work to be described, would have had dffiiculty in securing returns. Additionally we secured shells at Teepeeota Point through several inches of water weed.

In the report on conditions in 1920 it was indicated that the proportions of mud and sand in the river bottom increase perceptibly in the vicinity of the tributary streams of the region, and it was stated that the Chippewa river was largely responsible for the enormous quantities of sand brought into the areas surveyed by the party below Lake Pepin. Mention was also made of the fact that only through the construction of wing dams, (formerly of stone, but now of stone, brush, or even sand), have the government engineers been able to preserve a navigable channel in the regions surveyed by the party. These dams are designed to catch the sand near midstream, deflecting it toward the shore where it ultimately forms sand bars and islands, but it unfortunately at the same time smothers the valuable clam beds which formerly existed in these regions, with the consequent discouragement of the clamming industry.* While the Engineering Corps is administering what will undoubtedly constitute a cure for the conditions they find, the writer is impelled to point out that coordinated action in reconstructive conservative measures at the present time, may eventually lighten the burden of the separate agencies working upon the various phases of conservation of our natural resources.

The situation and the method of meeting it is described

* According to Inspector C. G. Weyl, U. S. E., Fountain City, Wisconsin, these wing dams are built to a height of 4½ ft. above low water stage, except for 6 miles above Winona, Minn., where they are from 7 to 7½ ft. above. In that portion of the river with which we are concerned, the width of the river from the end of the dams to the opposite shore is 525 ft. Below Winona, however, this width is 625 ft.

from the engineering standpoint in the following letter, dated Oct. 22, 1925, from Major C. F. Williams, U.S.E., District Engineer of the region in which the survey was made:

"Except for the rapids at Rock Island and Keokuk the upper Mississippi River from the Twin Cities to the mouth of the Missouri River is characterized by flat low water slope, gentle current, bed of sand and gravel, and banks from eight to fifteen feet high. The channel consists of alternate pools, ten to twenty feet deep, and shoals which in low water formerly had a depth sometimes as small as one or two feet. The pools occur in the bends while the shoals or bars are in the straight reaches where the channel crosses from one bank to the other, hence their designation as "crossings."

With the completion of the early improvements by the Federal Government in 1877 of the rapids mentioned above, the attention of the engineers was turned to the improvement of the depths over the crossings and since 1878 the scheme now in use has gradually developed.

In a stream with an easily eroded bed such as the Upper Mississippi, the depth is roughly inversely proportional to the width, and on this simple principle is based the scheme of improvement. Back sloughs and secondary channels are closed by low dams of rock and brush, (closing dams), so as to concentrate the entire low water flow in the main channel, and in places of excessive width the main channel is contracted by building dams of similar construction, (wing dams), out from one or both banks. In addition the channel is cleared by snagging and dredging, and banks subject to attack by erosive currents are protected by means of rip rap.

The above improvements were first designed to give a least depth of 4½ feet at low water and later to give 6 feet.

The following table shows the number of wing and closing dams built in the various sections in which you are interested:

OUR AREAS		Total dams completed by the fall of 1920	1925
VII.	(a) Read's Landing to Minneiska, Minn.	255	257
VIII.	(b) Minneiska, Minn., to Fountain City, Wis.	130	139
IX.	(c) Fountain City, Wis., to Winona, Minn.	83	83
X.	(d) Winona, Minn., to La Moille, Minn.	98	98

As you will notice, very few new dams have been placed in the past five years, nor are many more projected. Our work now consists largely in repairs and extensions to existing dams. Channel dredging of course goes on each year in various localities."

The information in the above letter which has the greatest bearing on the conservation of the mussel resources of this region is that the number of dams has increased in two of the areas surveyed by the party in 1920-1925. These are Area VII—Read's Landings to Minneiska and Area VIII, Minneiska, Minn. to Fountain City, Wis. The possible effects of these improvements upon the mussel beds of those areas will be brought out in the discussion of each of them. In this connection another letter of Major Williams under heading of Sept. 12, 1925, is of interest:

> . . . "You are informed that the works of regulation authorized between Diamond Island and La Moille have not been completed. The length of time necessary for the return of the river to its normal conditions after the construction of works of contraction is a variable depending on numerous conditions, a few of which are stages, conditions of reaches above and below and under improvement, method of improvement, and length of reach under improvement. However two years may be considered on the average. The construction of wing dams is still being carried on below Prescott, Minn. Above Prescott, that work has been suspended indefinitely until the matter of improvement by locks and dams has been settled."

From the second letter it seems evident that two years after the present authorized improvements have been completed, the river bottom may commence to return to conditions under which clams may prosper. No date is indicated as to when the works below Prescott, Minn., will in most probability be completed, and it is difficult to indicate the effect upon the clam beds, if these proposed improvements of the river above Prescott are carried through. Such conditions must necessarily be considered in any plans for the restocking with mussel life of depauperated sections of the river.

III.—STATUS OF THE MUSSEL FISHERIES IN RELATION TO THE PRECEDING.

That stretch of the river about five miles northwest of Red Wing in the vicinity of Diamond Island, and which is known to old-time clammers as the Trenton Bed, was little worked in 1920, but the whole region had been extensively clammed during the past 3-4 years. In 1925, nine rigs were in operation in the Red Wing region. Clammers estimated that 45-50 tons of shells had been produced, selling at $42.50 per ton. The record pearl secured was one of 45 grains. However, the complaint of the clammers was that the region had been extensively polluted by refuse from the St. Paul slaughter houses, rendering clamming operations unattractive. This pollution they observed as early as spring in the year.

Coincident and perhaps correlated with the disappearance of the enormous number of fish formerly seined at the head of Lake Pepin, is the diminution of the mussel resources of the region, Area III. At any rate mussel fishing in this region is considered unprofitable, although mussels are abundant just outside the lake in the river channel. About three and one-half miles from the head of Lake Pepin, we encountered two men and two women picking shells from a depth of about 3½ ft. of water. Although this was in a closed area, they did not have the impression that it was illegal to pick clams by hand. They stated that they could pick 10 bucketfuls per day, which at the rate of 70 bucketfuls to a ton would be worth over $3. One clammer had a 25-grain pearl, another, one of from 45-50 grains. Near Maiden Rock bluff, we also met three clammers, who were operating in the river above Lake Pepin. One reported 15 tons of shells thus far for the season's work, but he had collected only about $10 worth of pearls in two years!

The conditions encountered in the more productive part of Lake Pepin during the summer are best dealt with in the report prepared by J. B. Southall. Our work there was resumed in what will be referred to as Area VI, whose northern boundary is a line drawn between Pepin and King's Coulee. At that time, Aug. 26, we observed a number of rigs lying

idle at Pepin, and observed one rig to put in after a short try for shells. At the foot of Lake Pepin, the low stage of the water permited three clammers to capture mussels with pitchforks. Still another clammer was altruistically removing dead shells with the living ones, on the theory that their presence was harmful to the latter. Nine rigs were observed standing idle at Read's Landing. No pearls were reported to us from this section.

Clammers had been active in the vicinity of Wabasha since 1920, but we saw no rigs. However, the morning we were there as previously noted, a girl picked up seven bucketfuls of commercial shells in that period, but this was exceptional. Above the railroad station at Alma, we observed a pile of about 100 shells, principally niggerheads, pimple backs and pigtoes which had evidently been taken from the water by pitchfork or by hand for the pearls they contained. This was the sole activity in evidence from Read's to Minneiska. So far as our observations go, the few remnants of formerly extensive clam beds at or near Wabasha, Minn., Teepeeota Point, Alma and Fountain City, Wisconsin, and Minneiska, Minn., which we found in 1920, have practically disappeared or are in the process of extinction. The Wabasha bed was clammed out when we studied it this summer, but as it is favorably located, it would probably, if specially protected, regenerate rather rapidly. Dams constructed at Teepeeota Point and the rapidly growing water weed are slowly causing this section of the river to fill in and smother the clams. At Alma, it was found that a government barge laden with stone had sunk in the bed north of the Burlington Station, and that not all this stone had been recovered from the bottom. The clams which may remain in the bed are available only to hand pickers. Further down opposite the center of the town, we found that government engineers had dredged the channel the preceding year, pumping the sand over to the opposite river bank. This utterly destroyed our locality VII-14 of 1920. Exactly the same thing occurred at Fountain City, this summer, while we found that at Minneiska, above Fountain City, additional dams con-

structed in that vicinity, had deposited sand and silt on the remnant of the bed we found there in 1920.

In the report for 1920, it was suggested that the preceding beds, persisting as they had under unfavorable conditions for a number of years, offered fairly suitable conditions for restocking, since the older shells afforded some lodgment for younger ones until they could more readily resist the flow of the current. It is evident however that when such beds are destroyed outright or rendered inaccessible for fishery, that some loss to the mussel resources is occasioned. As first reported in 1920, stream pollution is still extensive at Alma, Fountain City and Minneiska, and if such no longer can effect the local clam beds, it may eventually cause damage to those further down stream, or inhibit the appearance of the older ones through the indestructible nature of the rubbish deposited upon them.

As a general rule, mussels were less numerous in the vicinity of sand bars created by dams in 1925 than in 1920. This of course, may have been the result of the contrasting conditions in the river during the summer and that of 1920. Where, however, sand bars in certain of the sloughs were explored, mussels were found to be quite numerous. In the river sand bars, the following species were most abundant in order: *Fusconaia undata, Amblema peruviana, Lampsilis ventricosa, Lasmigona complanata, Obliquaria reflexa,* while in the sloughs they were as follows: *Amblema peruviana, Fusconaia undata, Lampsilis ventricosa, Obovaria olivaria, Proptera laevissima.*

In many cases pockets of shells were discovered in the mud and sand accumulating between the dams. Such is represented by our locality VIII-14. At other times they were found in the ponds formed by high water behind the normal shore line. Near Fountain City we met a fish rescue crew from Homer under H. P. Fellgate, which had just removed 2-3,000 game fish under five inches in length from such a pond 175-200 ft. in length, with an average width of from 10-12 ft. With a total of seven people collecting by hand there were removed from this pond in half an hour a total of 374 living

mussels, of which over four-fifths were commercial species of a marketable size. These shells were restored to the river at this point. While their market value may not have justified the efforts of the average clammer, on the other hand the reproductive potentialities of these animals in a region scarce of mussel life is much greater. In 1920, it was recommended that mussels be taken from the sandbars by hand when desirable for commercial purposes, and that when in danger of stranding, these creatures be given the same conserving care as fish receive in the rescue work. Such a recommendation is extended to mussels found trapped in such ponds or anywhere where their life is in danger of curtailment. The two localities stocked with shells in 1920 by the party, which they had removed from the sandbars with the view of rechecking these localities in 1925, were found to be completely covered with sand.

As in 1920, the sloughs of the river below Lake Pepin and above Winona appeared to be richer in mussel life than the main river. Belvedere and Straight Sloughs are still good shell producers, although the latter, as will shortly be described, is in danger of depopulation of its mussel life. West Newton Chute at its upper end is now completely blocked off from the main river by sand pumped in by the engineers and while we found a few shells there, the slough is slowly filling up. The party made one of the best hauls of the trip at the lower end of the slough, (Loc. VII.-22) but here the bottom is principally mud, and it can not be long before the slough becomes inaccessible from the rivers for clammers, and ultimately only the more unprofitable, mud dwelling shells will survive. The low stages of the river prevented the use of crowfoot bars in these sloughs, and all records of them for 1925 are of the party picking by hand.

We entered the Straight Slough overland, from the vicinity of Winona, as the stage in the water was so low that we were unable to enter it with the boat. On the way we observed one clammer picking by hand in a branch of Crooked Slough and saw a pile of about two tons of commercial shells. Due to the low water stage, Crooked Slough was also crossed

by land, and we saw hundreds of dead shells where they had perished *in situ* as a result of the drought. Reports had reached us concerning the extent of the clamming operations during the summer in this region, and while some were obviously exaggerated, it is perfectly true that the low water deprived the mussels of some of their natural protection, and permitted far more of them to be taken than would be the case under ordinary circumstances. As will be more fully discussed later, young children were engaged in the work. Of course such a period of drouth but rarely occurs, but there is suggested immediately a legal limitation to the depth of water from which living clams may be taken under such conditions. Lack of such is conducive to the violation of the protective laws as will be clearly shown.

The party re-explored Straight Slough in a row-boat to the sites of the localities studied in 1920. Four men, and in some cases their families, were reported to be clamming in Straight Slough, which had more dead shells in its water and along its banks and more living young shells than any other section of the Mississippi studied. At Mr. Kline's place there were observed 3 tons of shells collected in two weeks' time from an inlet near his home, five-eighths of a mile long and 30 ft. wide. The pile contained yellow sand shells, three ridges, white heel splitters, bull heads, long johns, pink heel splitters, and spikes. The four children of this family picked by hand on the father's license. The family had collected only a few slugs, and expected to receive only $25 per ton for their shells under the opportunistic methods adopted by the shell buyers. The Klines reported an abundance of shells in Bartlett's Lake nearby. At Mr. McNally's place, a ton of shells had been collected by three children of the family. He reported one pearl selling for $25. In his pile we saw a dead specimen of *Quadrula granifera*, the first seen on the trip, while in the slough we saw our first specimen in 1925 of the bullhead, *Pleurobema aesopus*.

Above our locality IX-22 is located Sandy Creek which at high water connects Crooked Slough and Straight Slough. It was very nearly dry except at its mouth, and at about 50

yards back from the latter the former bottom was thickly covered with dead shells extending back about 100 yards in the channel. These shells gave indication of being buried by the sand or killed by some previous low water stage, rather than being taken and cut open for pearls. They were without exception, have grade shells for commercial purposes, and might have been conserved by rescue work.

As in 1920, we found that portions of Straight Slough and Belvedere Slough appeared to be favorable to the growth of shells as judged by the number of juvenile shells occurring here. With the exception of occasional small piles of shells evidently cut open by pearl hunters, the mussel resources of Belvedere Slough have not attracted clammers. As these sloughs are fed to some extent by local drainage and at places have a fairly rapid current, it is evident that even if they are filling up they will for some years offer a congenial environment to mussels, and may be a convenient source of material for propagation work below Lake Pepin. Additionally they present favorable places for restocking. When it is recalled that they are also the principal spawning grounds of fish from the river, it would seem perfectly clear that special legislation or administrative action in protecting them from exploitation is justified. Such action was taken in the case of Straight Slough during the past year when it was closed to seining by the Game Commissioner of the State of Minnesota. Under the conditions of low water described such an action would be justified for the protection against over-fishing of fresh water mussels.

It is worthy of note that in the vicinity of Winona there exist the most extensive clam beds occurring in the river between that city and Lake Pepin. It is remarkable also that the sand bars of the vicinity yield good returns on picking with the greatest abundance of juvenile shells. Presumably in this region the bottom conditions are favorable toward forming a clam bed, but it is the impression of the writer that further up the river there exist equally good places but with few or no shells. While mussels are thinly scattered in the river above Winona, they are still comparatively plentiful in

the parallel Straight Slough. Possibly the bed at Winona is so favorably located that it has but little trouble in keeping up a fair degree of regeneration, but the presence of many shells, mature and juvenile, on the sand bars of the vicinity suggests that the effects of the current are such that the bed may receive many shells from up stream. Now as the most bountiful and immediate supply of shells is in Straight Slough which opens into the Mississippi about half a mile above Winona, there is a strong probability that many shells find their way into the Mississippi at this point. If experiment shows this to be the case, we have an additional argument for the application of more stringent protective laws to the mussels of the sloughs.

Near Homer, Minn., below Winona, we encountered 3 clammers "frogging it," as they term picking by hand and the best information had was that six or eight clammers had worked the beds in the vicinity of Wniona that summer. Clamming in this region was reported to have increased considerably in the past three years.

Reasons, then, commonly assigned in 1920 within the regions surveyed for the depletion of the mussel resources, and the consequent decline of the clamming industry are still found to hold in 1925, viz.:

1. The smothering of the mussel beds by sand deflected by the dams as already indicated. Additionally, it may be stated that the increased velocity of current thereby insured has the probable effect of sweeping juveniles just dropped from fish, or more mature mussels, long distances down stream, or to lodge them upon sand bars where they may be covered up unless specially rescued.

2. Destructive fishing methods such as taking very young shells, deliberately clamming out beds and fishing with the shoulder rake are also responsible. Favorable sentiment toward respecting the protective laws is characteristic of the professional clammer, but still a great deal of damage is done by the occasional or less experienced fishermen who in many cases submit immature shells to the buyers. According to the clammers, the latter make the situation worse by accept-

ing them. Under this category there may also be included the cases mentioned where more than one individual clams on a single license, and where conditions of extremely low water permit the clams to be picked in greater numbers than under ordinary circumstances.

3. The growth of formerly extensive clam beds near communities situated along the river has been inhibited by the pernicious practice of dumping rubbish of somewhat indestructible nature in the river at these localities. While State laws are also clear on these points the enforcement of them seems largely a matter of local sentiment. The *hinterland* of the regions involved is still so productive that it seems difficult to arouse the people to the relation of this practice to the conservation of all aquatic resources.

To these may be added a fourth reason due to the lack of a correlating factor between different agencies of the government working for conservation—that of the destruction of clam beds by channel dredging activities. The writer at present finds it impossible to say whether the clams now destroyed by this practice could be conserved by any ready means.

When the preceding data on general conditions in the areas and the status of the mussel fisheries are considered in entirety, it becomes evident that before the mussel resources of these areas can be improved, some practicable basis must be determined from which measures looking forward to their fullest protection and conservation can be inaugurated. A study of this nature then will show when and where this is likely to be obtained by the enaction of protective laws, and when, where, and why such are likely to fail in bringing results as fast as might be anticipated. Such data is also apt to be useful for the future guidance of this branch of conservation activities. Hence the reason for this study and appraisal of mussel resources in certain areas of Wisconsin and Minnesota, the region in which a large percentage of the commercial shells are produced.

IV.—METHODS.

(a.) Description of Outfit for Collection of Shells.

The work was approached from the standpoint of the mussel fisherman, a bar and crowfoot outfit, (john boat), being used to collect the shells. The outfit was towed from place to place by a Government launch. In the areas in and above Lake Pepin, (I-VI. inc,) 100 hooks were attached to each of the 16-ft. bars. Below Lake Pepin, starting at Read's Landing, (areas VII-X inclusive), the river bottom is heavily infested with snags, so the bars were shortened to 10 ft. with a consequent reduction in the number of hooks on each to 75. In the first named areas, the data forming the basis of the conclusions presented, comprises the results of three trials of the same length of drag with the bars, (300 ft.), at each of the localities indicated. In the remaining areas, the number of drags was increased from three to four, to compensate for the reduction in the number of hooks, but otherwise the procedure was the same. Additionally, the john boat had at its bow, a hand windlass bearing three hundred feet of five-eighths inch line, to the free end of which an anchor was attached. In proceeding from one locality to another, the windlass was locked, and the boat towed by a separate piece of rope.

(b). Collecting Mussels for Study and Appraisal.

When it was decided to appraise a particular locality, a starting point was determined by methods shortly to be described, the windlass and the tow-line were released, and the launch going ahead unreeled the 300 ft. of line into the water until it was very nearly taut, when the operator of the launch dropped the anchor at the free end. For the purpose of temporarily anchoring the john-boat while the line was being payed out, one of the bars, usually that one to be placed to the rear, was at favorable opportunity, dropped into the water in such a way that it lay at right angles with the shore, and dragged parallel to it. When it had touched bottom, it was seuured into position by means of props and by knotting its rope around one of the uprights. As soon thereafter as the boat had swung into a favorable position to render less likely

the entangling of the hooks of the bars, the remaining bar was dropped and secured likewise.

After the anchor was dropped and the bars properly spread, one of the two operators in the john boat windlassed the latter by slow and steady turns up to the point where the anchor had been dropped, observing from time to time the relative apparent motion of the shore line to make certain that snagging or fouling of the bars was not causing the john boat to pull the anchor towards it in the meantime. When such was found to be the case, the bars were pulled up, the catch discarded and a new trial made. When the john boat had been properly windlassed up to the anchor, the latter and the bars were pulled up, the mussels taken off the hooks and thrown into a tub. The launch then towed the john boat back to the original starting place, when this procedure was repeated twice again for each locality, the mussels obtained from the 3 trials being counted together. Dead shells obtained were recorded separately. Other biological spceimens obtained through this procedure were sent to various specialists for identification, and the results of their work which is hereby gratefully acknowledged, is comprised in the notes on the various areas. The special dredge carried by the party in 1920 to determine the conditions on the bottom of the river, and for the purpose of securing material for a special study of juvenile mussels was not used in 1925, as there seemed to be no special reason for obtaining additional data of this type.

(c). Determination of Localities.

The course of the river was followed by means of a set of maps of the river published by the Mississippi River Commission and by a copy of the current edition of the light list for the 13th Lighthouse District as in use by navigators on the river in 1920 and 1925. Comparison of these indicated the extent to which the Government Day marks used as land marks in the investigation had changed in position during the past five years. The position of each locality surveyed is indicated on the maps used, which are now in possession of the U. S. Biological Station, Fairport, Iowa. On these maps, the

localities are numbered according to area, and to the order in which they were examined. Thus I-3 on the map indicates Area I and the third locality in it. References to the data to follow should be similarly understood. As previously indicated, only the three best localities in each area are reported upon.

It was not found practicable to draw into the maps these localities on an exact scale. The markings largely indicate the relative position of the locality with regard to the shore line at the time, the more absolute one being obtained by reference to the descriptive material given in connection with the marking on the maps. The more absolute data concerning the position of the locality was obtained by reference to some object or formation along the shore which seemed of a fairly permanent nature, such as the Government Lights or Day Marks or other improvements along the river, ravines, elevation of adjacent hills, clumps of bushes, trestles, etc. The first two types of reference points were not used when anything better could be observed. The light list referred to gives the distance of these marks and lights from more accurately defined points such as bridges, etc. As data furnished by local clammers was sometimes found to be misleading, positions of productive shell beds were frequently determined by a trial drag with a single bar at varying distances from the shore, when, after encouraging results, the three consecutive drags with both bars were attempted. All beds of shells of fair extent which the party encountered are also indicated upon the maps mentioned.

Once the reference point was established, the distance across the water of the starting point of the drag from this was estimated independently by the three members of the party. The average taken of these distances is that one given in the descriptive material of the localities and in case of great variation in estimate, the more probable distance was verified by measurement of other points on the map within sight and by the making of comparisons. A map case of the type used in the U. S. Army provided with compass and transparent water proof cover was found to be a convenient carrier for the maps in the field, and on it the localities could be promptly

located. A spring back aluminum binder was found to be serviceably adaptable for holding the mussel survey sheets used for the recording of data. It should be born in mind, however, that as the larger portion of the work was accomplished under conditions of low water in 1925, it was difficult to accurately estimate the position of the normal shore line, and the distances given are those of the position of the outfit from the nearest land above water at the time.

V.—LIST OF SPECIES COLLECTED.

The following list embraces those species of mussels collected within the areas surveyed.* Besides indicating the common name by which mussels are known to clammers, the older scientific names of Simpson's Descriptive Catalogue of the Naiades are given, and their equivalent in the recent Pilsbry-Ortman-Walker nomenclature, which follows more closely the rules of modern taxonomy so far as they concern the mussels.

* For a complete list of the Naiades of the Upper Mississippi Drainage see Grier, N. M., *Nautilus*, 36.

COMMON NAME	SCIENTIFIC NAME	
Commercial Species	*After Simpson*	*After Pilsbry, Ortmann & Walker*
Niggerhead	Quadrula ebenus	Fusconaia ebena (Lea.)
Niggerhead	Quadrula solida	Pleurobema catillus (Con.)
Hickory Nut	Obovaria ellipsis	Obovaria olivaria (Raf.)
Pimple Back	Quadrula pustulosa	Quadrula pustulosa (Lea.)
Maple Leaf	Quadrula lachrymosa	Quadrula quadrula (Raf.)
Monkey Face	Quadrula metanevra	Quadrula metanevra (Raf.)
Purple Pimple Back	Quadrula tuberculata	Rotundaria granifera (Lea.)
Three Horn Warty Back	Obliquaria reflexa	Obliquaria reflexa (Raf.)
Pig Toe	Quadrula undata	Fusconaia undata (Barnes)
Blue-Point	Quadrula plicata	Amblema peruviana (Lam.)
Three-Ridge	Quadrula undulata	Amblema costata (Raf.)
Wash Board	Quadrula heros	Megalonaias heros (Say.)
Buck Horn	Tritogonia tuberculata	Quadrula verrucosa (Raf.)
Mucket	Lampsilis ligamentina	Actinonais carinata (Barnes)
Higgin's Eye	Lampsilis higginsii	Lampsilis higginsii (Lea.)
Lake Pepin Mucket	Lampsilis luteola	Lampsilis siliquoidea (Barnes)
Butterfly	Plagiola securis	Plagiola lineolata (Raf.)
Deer Toe	Plagiola elegans	Amygdalonais truncata (Raf.)
Pocket Book	Lampsilis ventricosa	Lampsilis ventricosa (Barnes)
Yellow Sand Shell	Lampsilis anodontoides	Lampsilis anodontoides (Lea.)
Slough Sand Shell	Lampsilis fallaciosa	Lampsilis fallaciosa (Smith.)
Black Sand Shell	Lampsilis recta	Eurynia recta (Lam.)

Bull Head	Pleurobema aesopus	Plethobasus cyphyus (Raf.)
(No Common Name)	Lampsilis subrostrata	Eurynia subrostrata (Say.)
White Heel Splitter	Symphynota complanata	Lasmigona complanata (Barnes)
Fluted Shell	Symphynota costata	Lasmigona costata (Raf.)
Pink Heel Splitter	Lampsilis alata	Prostera alata (Say.)
Rock Pocket Book	Arcidens confragosus	Arcidens confragosus (Say.)
Elephant Ear	Unio crassidens	Elliptio niger (Raf.)
Spike	Unio gibbosus	Elliptio dilatatus (Raf.)
Ohio River Pig Toe (?)	Pleurobema pyramidatus	Pleurobema pyramidatum (Lam.)
Elk Toe	Alasmidonta marginata	Alasmidonta marginata (Say.)
Sugar Spoon	Plagiola donaciformis	Amygdalonaias donaciformis (Lea.)

NON-COMMERCIAL SPECIES

Floater	Anodonta grandis	Anodonta grandis (Say.)
Slop Bucket	Anodonta corpulenta	Anodonta corpulenta (Cooper)
Paper Shell	Anodonta imbecillis	Anodonta imbecillis (Say.)
Squaw Foot	Strophitus edentulus	Strophitus edentulus (Say.)
Paper Shell	Lampsilis gracilis	Leptodea fragilis (Raf.)
Paper Shell	Lampsilis laevissima	Proptera laevissima (Lea.)
Snuff Box	Lampsilis parva	Carunculina parva (Barnes.)
(No common name)	Truncilla triquetra	Truncilla triquetra (Raf.)

VI.—RESULTS AND OBSERVATIONS.

These include data compiled upon the absolute and relative abundance of each species of mussel found in the areas appraised, together with such geographical or other information likely to be of use in expediting the rechecking of these results after a period of protection, or which might have a bearing upon propagation experiments. The number of shells of each species collected in each locality is given under the heading of the latter, and the percentage of this in the total catch in the locality is indicated. The average of the three percentages thus obtained for each species in each area is taken to represent the relative abundance of that species in the area. An asterisk indicates that the species was found to be less than 1% in the area and locality involved. A blank space opposite the name of a species indicates that living shells were not collected in either the area or the localities of it.

AREA I.

Boundaries, lower half of Diamond Island, Miss. R. to Red Wing, Minn., at high bridge. Status, open to fishery in 1920, closed in 1925. Length in linear miles 4.2. Physical conditions, 1920, estimated 7-8 ft. high water. Current, about 5 miles per hour. Bottom mostly gravel and sand. Middle sections of area infested with snags. Water at least 5 ft. below normal stage in 1925.

Localities Reported Upon. (Ref. Maps.)

1-1. Starting point of drags Government Day Mark 958-n near center of Diamond Island, 25 ft. from shore on Minnesota side of channel. July 7, 1920. Aug. 19, 1925, bottom covered with decaying organic matter. Drags 5, 15, 25 ft. from the shore.

1-2. Starting point of drags Government Day Mark 958-k, (above island 23), on Wisconsin side of channel, 30 ft. from shore, about one-half mile down stream from the preceding locality, July 7, 1920. Aug. 19, 1925, bottom covered with decaying organic matter. Drags 15, 25, 50 ft. from shore.

1-6. Starting point of drags 300 ft. upstream from Government Day Mark 958-g across the mouth of a slough about one mile above Red Wing on the Minnesota side, 50 ft. from the mouth of the slough. July 9, 1920. Aug. 20, 1925, slough largely filled up, bottom muddy, water weeds growing out from the shore. Drags 10, 25, 40 ft. from the shore.

Notes on Area I.

Rotundaria granifera, reported absent from this area in 1920 was not collected by us here in 1925 if it has reappeared, while our northernmost record for *Arcidens confragosus* was obtained near Trenton village.

A marked decline during the past five years was noted in the absolute abundance of mussels in this area,* which is not surprising in view of the fact that the region was extensively clammed during the past few years, and has also been subject to extensive stream pollution. As regards the relative abundance of shells in this area it was observed for commercial species that there was an appreciable increase in the number of pimple backs, pigtoes, blue points, buckhorns, pocketbooks and a decrease in hickory nuts, river muckets, Lake Pepin muckets. This decrease is seen to concern the more valuable shells for button making. Increases among the non-commercial shells were evident in the squaw foot and one of the paper shells *(Proptera lævissima).* From the fact that the clammers discard many of the non-commercial species upon catching, it might be thought that these species would be favored to the extent that they would become dominating species in an extensively clammed area. As a matter of fact decided decreases in their absolute and relative abundance were noted over 1920. According to the calculated data of the table they made up less of the clam bed in 1925 than they did in 1920. Further study may show the extent to which the thin, non-commercial shells through complicated relation-

* EDITOR'S NOTE: As it has been found impracticable to reproduce with the manuscript the statistical tables originally accompanying it, those interested further may have access to these tables by applying to Mr. T. K. Chamberlain, Director, U. S. Biological Station, Fairport, Iowa.

ships of one kind or another are active agents for the welfare of their thicker shelled brethren, beyond merely representing an adaptation enabling them to survive the changing conditions of the river bottom.

In the relative abundance of species represented, the area is distinctly a "pocketbook" area, the pink heel splitters, blue points and pigtoes being next in abundance; in general the thinner type of species seems most highly favored. The writer was impressed by the almost uniform absence of juveniles in this area in 1925, their place in the river bottom society being taken perhaps by the extremely common Sphaeridae which were brought into the boat by the hundreds on the windlass line. The principal species represented was *Sphaerium stamineum* Conrad. Many dead and dying shells were observed along the banks in this area.

Commencing about a mile above Red Wing, water weeds were rather common in this area and included species of *Philotria*, (*Elodea*), *Potamogeton crispus* and *americanus*, *Zannichelia palustris*, *Ruppia occidentalis*, *Ceratophyllum demersum*, and *Vallisneria spiralis*. Leeches collected crawling about on the mussel shells were pronounced by Professor J. Percy Moore of the Zoological Laboratory, University of Pennsylvania, to be *Glossosisphonia complanata*, *Helobdella stagnal's*, and *Erpobdella stagnalis*. Aquatic insects and crustacea similarly collected were determined by Professor J. G. Needham of Cornell University to be the larvae of the damsel flies, *Ischnura verticalis*, *Enallagma* sp. and the orchestid crustacean, *Hyalella Knickerbockeri* Bate.

(To be continued.)

INTERNATIONAL CONGRESS OF PLANT SCIENCES

(*Fourth International Botanical Congress*)

Investigators and teachers in the plant sciences, representing all aspects of botany, plant chemistry, plant pathology, and bacteriology, agronomy, horticulture, and forestry are invited to attend the International Congress of Plant Sciences to be held at Ithaca, August 16-23, 1926. This invitation is extended to all countries of the world.

This Congress is scheduled to follow the usual academic sessions in the United States. It is believed to offer the first opportunity ever arranged in the United States for a general conference of all those professionally engaged in plant work. It possesses the additional compelling interest accruing from unrestricted international representation.

In order that a part of the program may be representative of outstanding leadership, the Congress will be divided into about one dozen sections, each section with an invitation program occupying about four morning sessions or a little more than one-fourth of the available time. These formal programs will be supplemented by another feature that promises also to be of exceptional interest. Ample time will be set apart for round table or informal discussions, which in some cases may be scheduled in advance, and in others may be arranged both as to topics and participation after the Congress actually convenes. This is intended to provide for the widest participation in sectional activities. Supplementary opportunities for individual contact and participation are made possible through the non-commercial exhibits and through the provision for excursions and inspection tours of various types suited to the diverse needs of the different sections.

Although the Congress is not to provide an occasion for *legislation* on regulatory matters of international significance (such as nomenolatorial rules) the organization committee has expressly provided that "adequate opportunity shall be accorded all sections for the *discussion* of regulatory recommendations of international significance," in order that a bet-

ter understanding may be reached for definite action at a subsequent international congress.

The sections thus far authorized and the secretaries representing these groups are as follows:

Agronomy—C. H. Myers, Cornell University, Ithaca, N. Y.
Bacteriology—J. M. Sherman, Cornell University, Ithaca, N. Y.
Cytology—L. W. Sharp, Cornell University, Ithaca, N. Y.
Morphology, Histology and Palecbotany—D. S. Johnson, Johns Hopkins University, Baltimore, Md.
Forestry—R. S. Hosmer, Cornell University, Ithaca, N. Y.
Horticulture—A. J. Heinicke, Cornell University, Ithaca, N. Y.
Genetics—C. E. Allen, University of Wisconsin, Madison, Wis.
Physiology—O. F. Curtis, Cornell University, Ithaca, N. Y.
Pathology—Donald Reddick, Cornell University, Ithaca, N. Y.
Pharmacognomy and Pharmaceutical Botany—H. W. Youngken, Massachusetts Col. of Pharmacy, Boston.
Texonomy—K. M. Wiegand, Cornell University, Ithaca, N. Y.
Mycology—H. M. Fitzpatrick, Cornell University, Ithaca, N .Y.
Ecology—H. L. Shantz, Bureau of Plant Industry, Washington, D. C.

Communications regarding the Congress should be addressed as indicated below:

1. Concerning round tables and other strictly sectional matters—to the appropriate sectional secretary.

2. Concerning exhibits and general program matters—L. W. Sharp, Cornell University, Ithaca, N. Y.

3. Concerning excursions, collecting trips, inspection tours, local arrangements, transportation, etc.—H. H. Whetzel, Cornell University, Ithaca, N .Y.

4. Concerning the Congress in general—B. M. Duggar, Missouri Botanical Garden, St. Louis, Mo.

The American Midland Naturalist

PUBLISHED BI-MONTHLY BY THE UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA

VOL. X. JULY and SEPTEMBER, 1926. Nos. 4 and 5.

Report on the Study and Appraisal of Mussel Resources in Selected Areas of the Upper Mississippi River, 1920-25.*

N. M. GRIER,

DARTMOUTH COLLEGE HANOVER, N. H.

(Conclusion)

AREA II.

Boundaries, Red Wing, Minn., to Bay City, Wis., Status, closed to fishery in 1920, open in 1925. Length in linear miles, 5.8, physical conditions, 1920, 7 ft. high water, current about 3 miles per hour. Bottom mostly sand and mud, snags more abundant toward Wisconsin shore. Water weed in lower stretches of area. Water at least five feet below normal stage, in 1925.

Localities Reported Upon, (Ref. Maps).

II-1. Starting point of drags 300 ft. upstream off Wisconsin shore from Government Day Mark 958-c on edge of main channel about 40 ft. from shore, July 10, 1920. Aug. 20, 1925, starting point about 300 ft. above where Day Mark was in 1925, opposite small inlet, 25, 40, and 50 ft. from shore. Bottom showing evidence of decaying organic matter.

II-2. Starting point of drags 35 ft. from shore about ¼ mile downstream from Government Day Mark 958-d opposite bathing houses and summer camp on Minnesota shore, July 10, 1920. Aug. 22, 1925 drags 40, 60, 75 ft. from shore below Day Mark 958-c, former locality of 958-d. Bottom showing evidence of decaying organic matter, with refuse flowing on the surface.

II-4. Starting point of drags 100 ft. downstream from Government Day Mark 958-b, 45 ft. from Minnesota shore, July 10, 1920. Aug. 22, 1925, drags 12, 25 and 40 ft. from shore. Bottom muddy, free from snags.

Notes on Area II.

The data obtained for this area is of interest as indicating how certain species of shells have become localized in parts of it, and have remained so over the five-year period. As this area became open to fishery during the last year, an increase in the absolute abundance of shells in 1925 over 1920 should be demonstrated if the protective laws were the sole factor at work. This increase however was noted in but one locality and for commercial species only. As regards the relative abundance of shells in these areas it was observed for commercial species that there have been small increases in the pimple backs, blue points, river muckets, and larger ones in the Lake Pepin muckets and pocketbooks. The greatest decrease in commercial shells is shown in the hickory nuts with smaller decreases in the three ridges and long johns. Of the non-commercial species observed the majority, (including the *Anodontas* and *Leptodea fragilis*), show decreases in both the absolute and relative abundance of shells. *Strophitus edentulus*, whose button making potentialities have been considered from a genetical standpoint, shows a slight increase in abundance.

In view of what has been presented concerning these shells in the discussion concerning Area I, the losses in the larger species of *Anondonta* are remarkable. To the writer, the data presented as a whole indicates an unhealthy condition for mussel life in the area, possibly due to the stream pollution of which some amount has already been given. Masses of refuse covered with blue green algae were common on the surface of the water one mile below Red Wing. Pocketbooks were present in this area to a greater extent than the previous one, and with hickory nuts and Lake Pepin muckets are the dominating group of shells. The relative increase in the number of Lake Pepin muckets should be a source of gratification to those concerned with propagation of this species in Lake Pepin, as

the proportion obtained from a locality fairly near the lake is greater in 1925 than it was in 1920. It is encouraging also to note that the number of juveniles collected in this area in 1925 is greater than it was in 1920, especially of the last named species. *Quadrula verrucosa, Lasmigona complanata,* and *Amygdalonaias donaciformis* were not encountered in this area during 1925.

The water weeds and *Sphaeridae* previously mentioned continued abundant. Dense growths of *Sagittaria latifolia* bordered the river in the lower portions of the area, and the masses of dead *Lemna,* (duck weed) on the shores resembled burnt cork particles. Algae associated with the refuse were sent to Dr. W. R. Taylor, Botanical Laboratory, University of Pennsylvania and determined by him to be the following: *Tribonema* sp., *Oscillatoria tenuis, Oscillatoria prolifica, Oscillatoria chalybdea, Oscillatoria splendida, Clalthrocystis aeruginosa, Arthrospira Jenneri.* Associated with these were the following species of diatoms determined by Mr. Paul Conger of the U. S. National Museum to be *Asterionella formosa* Hassal, *Cocconeis Pediculus* Ehr., *Cocconeis Placentula* Ehr., *Cymatopleura solea* (Breb.) Ralfs., *Diatoma vulgare* Bory, *Encyonema turgidum* Grun., *Epithemia Zebra* (Ehr.) Kütz, *Frustulia rhomboides* (Ehr.) DT., *Hantzschia Amphioxys* Grun., *Melosira granulata* (Ehr.) Ralfs., *Melosira roeseana* Rabh., *Melosira subflexilis* Kütz, *Navicula appendiculata* (Ag.) Kütz., *Navioula Bacillum* Ehr., *Navicula cryptocephala* Kütz., *Navicula cuspidata* Kütz, *Navicula pygmaea* Kütz., *Navicula Reinhardtii* Grun., *Nitzschia acicularis* (Kütz.) W. Sm. *Nitzschia littoralis* Grun., *Nitzschia Sigma* var. *rigida* (Kütz.) Grun., *Pleurosigma acuminatum* (Kütz.) Grun., *Pleurosigma scalproides* Rabh., *Pleurosigma Spencerii* var. *acutiuscula* Grun., *Stephanodiscus Astraea* (Ehr.) Grun., *Surirella apiculata* W. Sm., *Surirella ovata* Kütz., *Synedra delicatissima* W. Sm.

Attention may be recalled to the very productive bed of shells existing in the channel of the Mississippi river in the vicinity of our locality II-7, near which the river enters the lake.

AREA III.

Boundaries, Bay City, Wis., to Maiden Rock, Wis., and Frontenac, Minn. Status, subject to fishery in 1920, closed to fishery in 1925. Length in linear miles, 5.7. Physical conditions, 1920, 7 ft. high water. Current about 2 miles per hour, bottom; gravel, mud with some sand. Comparatively free from snags. Water weeds common in upper stretches of area. Water at least 5 ft. below normal stage in 1925.

Localities Reported Upon. (Ref. Maps.)

III-1. Lake Pepin, starting point of drags 1500 ft. towards point with Government Light 957, from Wacouta Point, Minn., 100 ft. from shore, starting at a clump of low willows July 14, 1920. Aug. 24, 1925, drags 75, 100, 115 ft. from shore. Bottom snaggy.

III-4. About two miles below Bay City on Wisconsin shore starting a clump of willows and poplars at lower end of promontory with an altitude of 680. Drags 75 ft. off shore, July 15, 1920. Aug. 24, 1925, drags 15, 25 and 40 ft. from shore. Bottom snaggy.

III-8. Drags from Point No Point to Frontenac Point in a straight line between them, starting 300 ft. from shore of first and finishing 75 ft. from shore of second, July 16, 1920. Aug. 25, 1925, drags starting 250 ft. diagonally from shore of Point No Point toward Frontenac, 60, 80, and 40 ft. from shore.

Notes on Area III.

Obovaria ellipsis, Lampsilis higginsii, Obliquaria reflexa, Lasmigona complanata, Elliptio niger were not collected in this area by us in 1925, while we obtained here for the first time *Amygdalonais truncata, Lampsilis fallaciosa*, a single specimen of *Quadrula verrucosa*, and several specimens of *Quadrula metanevra*, and *Proptera laevissima*.

As a rule there has been no absolute decrease in the number of shells except in the locality nearest the head of the lake, in both commercial and non-commercial shells. Relatively, there has been an appreciable increase in the following commercial species; washboards, Lake Pepin muckets, long johns, and spikes; appreciable decreases are shown in the pig-

toes and pink heel splitters. It is again possible that the increase in Lake Pepin muckets may be attributed to the propagation work in this species carried on by the Bureau of Fisheries in the lake. Practically no change is recorded for the pocketbooks. It would seem that they should have increased in Lake Pepin if swept in from the upper river, but as clamming is most intensive in Lake Pepin, they may have taken in such numbers as to neutralize any normal increase. A relative decrease is noted for all species of non-commercial shells. This may be explained by clammers destroying them rather than being bothered by catching them again. In some instances this is known to be a fact.

Juveniles were less abundant than in 1920. In years gone by, a large portion of this area in the vicinity of Bay City was the site of a great deal of seining, but such is less frequently carried on now. The gradual filling in of the lake at its head or other factors contributing to the destruction of the feeding grounds of the fish, also contribute to conditions making for a scarcity of mussel life in that vicinity. Lake Pepin muckets, pig toes, blue points and spikes are the dominating shells of this area according to these observations, with all except the second species on the increase.

While our Loc. III-1 had been clammed 2-3 years ago we found it barren, with few or no dead shells on the shore. The water weeds already mentioned were present in abundance and many specimens of the snail *Campeloma subsolidum* Anthony, were associated with them. Additionally we found the water weed *Naias flexilis* at Maiden Rock. At one of our localities in this area we noticed for the first time during the trip, Aug. 4, 1925, the phenomenon of "breaking of the meres," although this may have occurred earlier in the sloughs further north. In 1920, these bluish green masses which were thick in the water of coves of the lake at that time, were identified by Dr. G. T. Moore, Director of the Missouri Botanical Garden as consisting of a mixture of *Clathrocystis serrigensa*, *Coelosphærium kuetzingianum*, and *Anabeana flos-aquae*. The fresh water sponge, *Spongilla fragilis* Leidy was common on submerged sticks and stones as well as the fresh water

bryozoan, *Pectinatella magnifica*. Damsel flies which were rather common at this time were determined by Mr. Hugo Kahl of the Carnegie Museum, Pittsburgh, Pa., to be a male specimen of *Enallagma carunculatum* Morse. Diatoms from the mud below low water mark, Lake Pepin, at Lake City, Minn., were determined by Mr. Conger to be *Cocconeis Pediculus* Ehr., *Cocconeis Placentula* Ehr., *Cymbella Mexicanum* (Ehr.) Mann (this species is vastly dominant in the sample), *Encyonema turgidum* Grun., *Gomphonema eriense* Grun., *Rhoicosphaenia curvata* var. *subacuta* A. S. (common in this sample), *Stephanodiscus Astraea* (Ehr.) Grun., *Synedra Goulardi* (Breb.) Grun., *Synedra ulna* Ehr.

AREA VI.

Boundaries, Pepin and King's Coulee to Read's Landing, Minn., Status closed to fisheries in 1920, open to in 1925. Length in linear miles, 4. Physical conditions in 1920, 4 ft. high water, current about 2 miles per hour. Bottom mud, sand with a great deal of water weed, on the Wisconsin side. Cobbles, gravel and riff-raff on the Minnesota shore. 1925, about 5 ft. of low water.

Localities Reported Upon. (Ref. Maps.)

VI-3. Starting point of drags, 700 ft. north of points marked 682.09 and 673.42 on map at foot of Lake Pepin, 500 ft. off shore, July 27, 1920. Aug. 27, 1925, drags 150, 100, 175 ft. from shore.

VI-5. Starting Point, 1000 ft. southwest of C. M. and St. P. R. R. trestle at culvert opposite Knud Johnston's coulee, (1760 elevation), 150 ft. from shore. July 28, 1920. Aug. 26, 1925, drags 75, 100, 125 ft. from shore.

VI. One mile upstream from bridge at Read's Landing, 300 ft. s. w. of C. M. & St. P. R. R. at base of stone quarry, 700 ft. from Minnesota shore, July 28, 1920. Aug. 28, 1925, drags 600, 700, 800 ft. from shore.

Notes on Area VI.

Fusconaja ebena, *Obovaria olivaria*, (except one deal shell), *Anodonta corpulenta*, *Rotundaria granifera* and *Aridens confragosus* were not collected by us in this area in 1925. On the

other hand, the following species absent in 1920 appeared in 1925: *Amblema costata, Megalonaias heros, Actionaias carinata, Lasmigona costata, Elliptio niger,* and *Truncilla triquetra.*

This area, recently opened to fishery, showed a marked decline in the absolute abundance of shells during the past five years. It is true that it had been intensively clammed during the summer, and that here we saw more clammers at work than on any other area of the Mississippi. A decline was found also in the absolute abundance of commercial shells for perhaps the reason cited. Appreciable increases in the relative abundance of commercial shells were seen only in the long johns. The Lake Pepin muckets appear to be hardly holding their own, while losses are shown by the pocketbooks, pigtoes, spikes and some minor species. These include *Anodonta grandis, Anodonta corpulenta,* and *Leptodea fragilis.* One-half of the non-commercial species show a relative loss.

Juvenile shells also show a marked decrease except in that section nearest the foot of the lake. It could hardly be said that the above data for this area indicated the presence of unfavorable conditions. There was no indication of stream polution and the clamming operations going on showed that clamming was unprofitable. The situation seems best explained by the fact that our rig did not obtain the shells at a time when clammers were obtaining them with pitchforks, and that what had been large beds before were now broken up into smaller units by the clamming operations which commenced with a rush when the area was reopened. The dominating species found in the area are in order the Lake Pepin muckets, (possibly as an effect of propagation experiments), pocket books, blue points, spikes, and long johns.

Dead shells were more numerous on the bottom of this area than any other with the exception of Straight Slough. Large numbers of them were young niggerheads. Many of them were still marketable, although there seemed to be no effort to take them. This condition was especially true of that portion of the lake south of Pepin where water weeds were abundant. Most of the shells we obtained at the foot

of Lake Pepin were young looking and their regular lines of growth indicated their origin in the lake. We found more spikes and elephant ears in this area than in any other.

The water weeds already mentioned were quite abundant at the foot of Lake Pepin. A brownish alga-growth from Lake Pepin, near Lake City, was determined by Dr. W. R. Taylor to consist of a growth of *Rhizoclonium* sp. covered with *Cymbella, Gomphonema, Cocconeis* and other diatoms. Other green algae forming green mats along the shore in the same vicinity were pronounced by him to consist of *Rhizoclonium heiroglyphicum, Clathrocystis* sp. and *Lyngbya majuscula.* Professor E. N. Transeau, Head of the Department of Botany, Ohio University, determined green algae from the shore of Lake Pepin near the ice house at Lake City to be *Oedogonium* sp. *Stigeoclonium* sp., and *Chaetophora incressata.* Another algae forming large yellowish green mats at the foot of Lake Pepin and particularly noticeable on account of the low stage of the water was pronounced by him to be mostly *Cladophora crispata* (Roth) Kuetzing. Mr. Conger determined diatoms associated with these algal mats to be *Cocconeis Pediculus* Ehr., (abundant here,), *Cocconeis Placentula* Ehr., (abundant here), *Cymbella granulata* (Ehr.) Ralfs, *Navicula Reinhardtii* Grun., *Nitzschia fonticola* Grun, *Rhoicosphaenia curvata* var. *subacuta* A. S. (abundant here), *Synedra Goulardi* (Breb.) Grun., *Synedra ulna* Ehr.

AREA VII.

Boundaries, Read's Landing, Minn., to Minneiska, Minn., Status, open to fishery 1920, closed in 1925. Length in linear miles, 20.9. Physical conditions, 1920, 5 ft. high water, current 4-6 miles per hour. Bottom sandy with many imbedded snags especially in the upper portions of areas.

Localities Reported Upon. (Ref. Maps).

A. Results with crowfoot bars.

VII-4. 320 ft. upstream from Government Light 946 along water front at Wabasha, 49 ft. from shore, July 31, 1920. Aug. 31, 1925, drags 40, 30, 60, 80 ft. from shore. Bottom snaggy.

VII-6. Teepeeota Point, 350 ft. west of willows at point,

150 ft. from shore line, July 31, 1920. Aug. 31, 1925, drags 35, 50, 75 and 20 ft. from shore. Bottom covered with water weeds.

VII-14. Off Alma, Wis., starting 450 ft. north of R. E. Jones Mill, 40 ft. from shore, Aug. 3, 1920. Sept. 1, 1925, drags 20, 40, 50 ft. from shore.

B. Results from picking by hand from sandbars.

Loc. VII-22. Sand bars northwest of Belvedere Island, Aug. 5, 1920. Sept. 2, 1925.

Loc. VII-23. Sandbars on island to left on entering West Newton Chute. Aug. 5, 1920. Sept. 2, 1925.

Loc. VII.-28. Sand bars off Belvedere Island, Miss. R., Aug. 6, 1920. Sept. 3, 1920.

Notes on Area VII.

Pleurobema catillus was not encountered in this area in 1925, while *Lampsilis fallaciosa* was collected here for our first time.

When we consider the results obtained by the use of the crowfoot bars, these indicate that there has been a marked decline in the absolute abundance of shells in this area in the past five years, both in commercial and non-commercial species. As however, conditions in the river below Lake Pepin did not permit us to form an accurate idea of the mussel resources by the use of the crowfoot bars, we substituted instead picking by hand from the sand bars. Since each drag occupied the space of 90 minutes in collecting and listing the shells, it was arranged that the three members of the party collect by hand with buckets and list the shells during a similar period. Where beds had been destroyed by the sand being pumped to the opposite side of the river, as in the case of those at Fountain City, Wisconsin, we collected on the sand bars thus formed and studied these results in place of those ordinarily obtained by using crowfoot bars.

When we considered the results obtained in 1925 by picking from the sand bars, we observed that there had been an increase in the relative abundance of shells on certain sand bars over what was found there in 1920, both in commercial and non-commercial species. When we studied, however, the

results obtained by the use of crowfoot bars we found that there had been an enormous increase in pocketbooks, and smaller ones in blue points while the Lake Pepin muckets showed on the whole a positive increase, possibly due again to the propagation work. The rest of the commoner commercial species generally showed losses.

Pigtoes, which showed a loss by the crowfoot bar results, exhibited a large increase when collected from the sand bars while three ridges, pocketbooks, and blue points on the sand bars are on the increase as well as white heel splitters. There is also an increase in floaters, while the number of Lake Pepin muckets, as collected from sand bars by hand show a loss.

While we found few enough juveniles in 1925, yet the total was greater than those found in 1920. So far as the clam beds in this area are concerned, pocketbooks, blue points, Lake Pepin muckets and deer toes are the dominating shells, while on the sand bars pocketbooks are still the most frequent shell followed by pigtoes, and white heel splitters, and in non-commercial species, by the floaters.

Elodea and *Ceratophyllum* were abundant in this area. In the pools behind the sand bars were abundant growths of algae determined by Professor O. E. Jennings, Head of the Department of Botany, University of Pittsburgh, to consist of the blue green algae *Anaboena Flos-aquae*, Breb., *Phormidium tenue* (Menegh.) Dument, *Oscillatoria* sp., *Clathrocystis aeruginosa* (Kuetz.) Henf. The green algae *Spirogyra* sp., *Hydrodictyon reticulatum*, *Scenedesmus quadricauda* (Turp.) Breb., *Scenedesmus incrassulatus* Breb. and the diatoms *Cymbella cuspidata* Kuetz., *Navicula* sp., *Synedra Vaucheriae* Kuetz., *Meridion constrictum*, *Cyclostella* sp., *Melosira* sp. Aquatic insect larvae and nymphs collected from a submerged log near Alma, Wis., consisted of nymphs of the dragon fly *Epicordulia princeps*, a leptid fly larva, perhaps *Atherix*, and many specimens of *Hydropsyche* sp. There were also nymphs of the stone fly. *Pteronarcys dorsata* and of the dragon fly, *Neurocordulia obsoleta* and larvae of parnid beetles. These were determined by Dr. J. G. Needham.

AREA VIII.

Boundaries, Minneiska, Minn., to Fountain City, Wis. Status, closed to fishery in 1920, open in 1925. Length in linear miles, 10.8. Physical conditions, 1920, 2 ft. high water, current about two miles per hour. Bottom, sand, mud, cobbles, riff-raff and infested with snags. 1925, about 4 ft. of low water.

Localities Reported Upon. (Ref. Maps.)

A. Results with crowfoot bars.

Loc. VIII-1. Starting at Government Light 902, 35 ft. off shore south of island 49, Aug. 11, 1920. Sept. 8, 1925, three-tenths mile upstream from 1925 location of this light, drags 15, 40, 50 and 70 ft. from shore with no results. Substituted collection by hand from sand bars on opposite side of river from this locality.

Loc. VIII-10. One-half mile around the bend from Government Light 896, 35 ft. off shore, starting point adjacent to coulee south of Chimney Rock, Aug. 14, 1920. Sept. 7, 1925. One-tenth of a mile downstream from 1925 location of the light, 3 drags with one bar 20, 40 and 60 ft. from shore with no results, and collection by hand from the sand bar opposite equally ineffective.

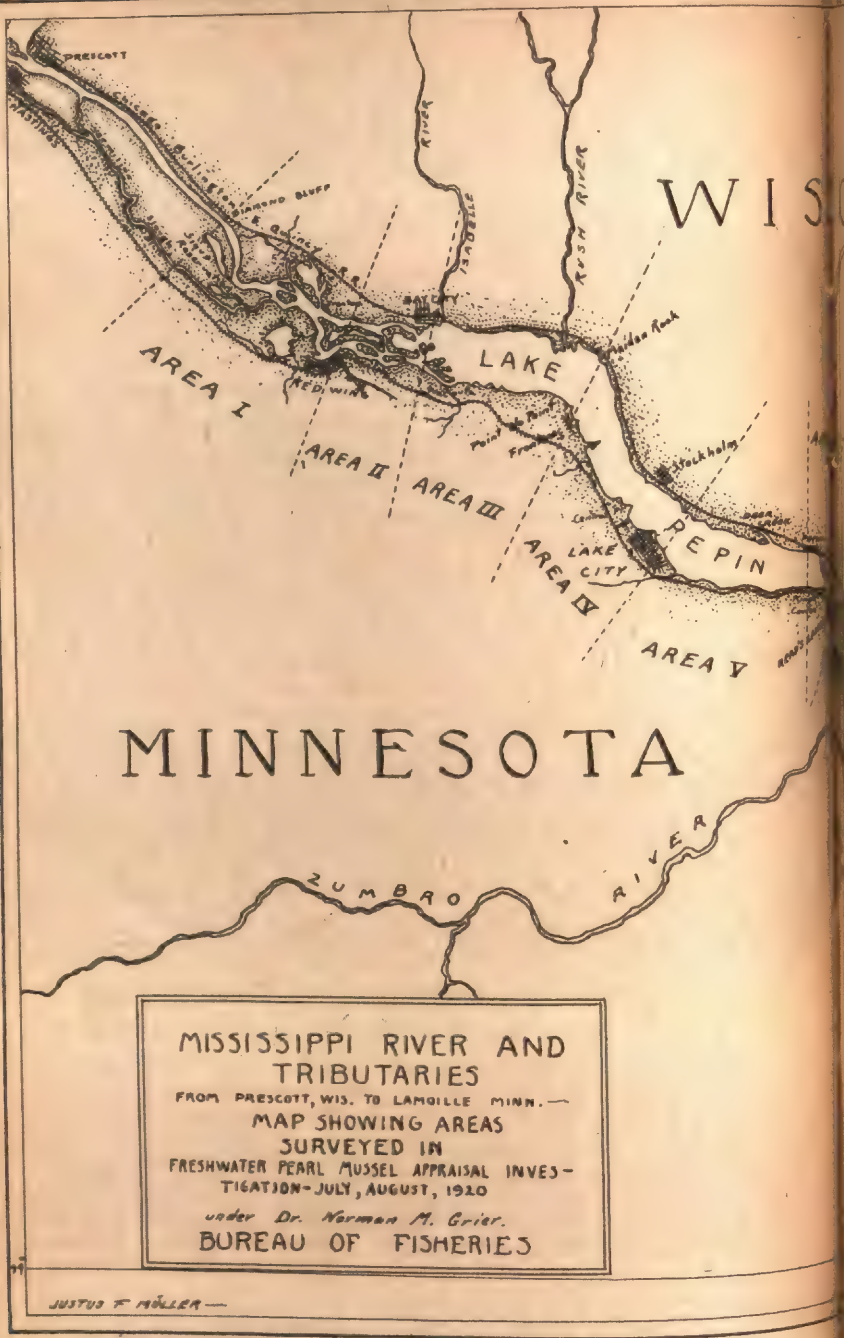
Loc. VIII-19. Straight Slough, 100 ft. south of the north end of the first large slough leading from it (at upper end), to the C. M. & St. P. R. R. tracks from 655 elevation on the opposite shore at distance of 20 ft. from tracks, Aug. 16, 1920. Sept. 8, 1925—the stage of water too low to permit entrance.

B. Results from picking by hand from sandbars.

Loc. VIII-4. Sandbar lower end of Belvedere Slough opposite 665 elevation on either bank and starting at 660 elevation on the island. Aug. 13, 1920.

Loc. VIII-5. Island and sand bar in Belvedere Slough in vicinity of map point B. M. 669.22; 665.29, Aug. 13, 1920.

Loc. VIII-14. Sand bars at end of Island 55. Aug. 16, 1920.



MISSISSIPPI RIVER AND TRIBUTARIES

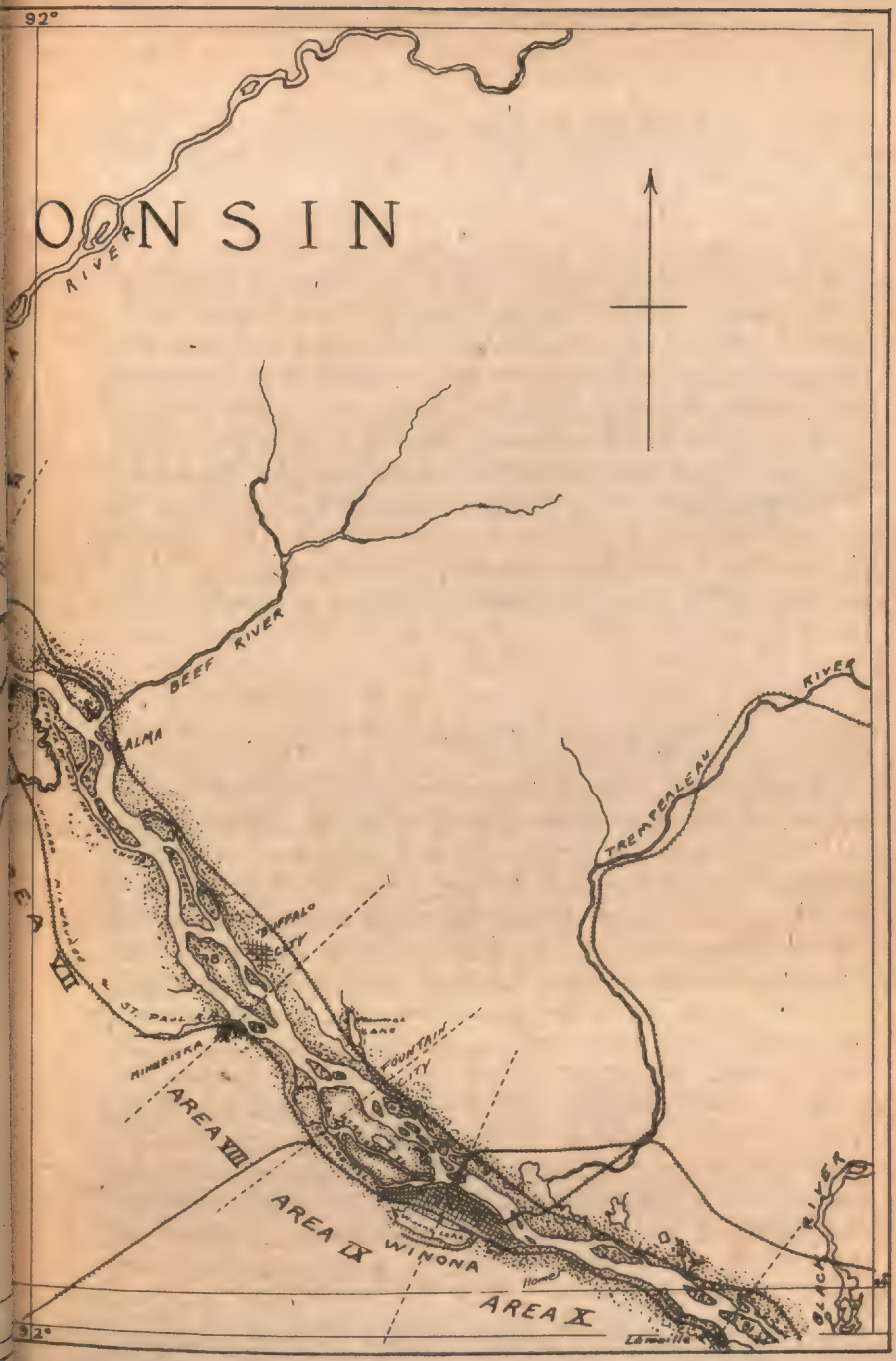
FROM PRESCOTT, WIS. TO LAMOILLE MINN.—

MAP SHOWING AREAS SURVEYED IN FRESHWATER PEARL MUSSEL APPRAISAL INVESTIGATION—JULY, AUGUST, 1920

under Dr. Norman M. Grier.

BUREAU OF FISHERIES

JUSTUS F. MÜLLER—


92°
ONSIN
RIVER
BEEF RIVER
ALMA
TREMPEALEAU
RIVER
BUFFALO
CITY
ST. PAUL
MINNESOTA
FOUNTAIN
CITY
AREA VIII
AREA IX
WINONA
AREA X
BLACK
RIVER
92°

Notes on Area VIII.

Dams constructed by the government destroyed Loc. VIII-1 and Loc. VIII-10 studied by the writer in 1920. In the first locality very few dead shells were found on the shore or sand bars where the locality formerly existed. We next investigated the sand bar on the opposite side of the river which had been formed since 1920 and found abundant dead bullheads, spikes, pocketbooks, niggerheads, three ridges, buckhorns, pigtoes, long johns, both kinds of muckets and heel splitters, and a few dead juveniles. There were a few living three ridges, buckhorns, pigtoes, long johns, both kinds of muckets and heel splitters, and a few dead juveniles. There were a few living three ridges and pigtoes. In the second locality mentioned, nothing was found on the sand bars opposite this point in the river indicating that this, the old Chimney Rock bed of the clammers, is destroyed.

Our results from the sandbars indicate an absence from this area in 1925 of the following species *Fusconaia ebena, Eurynia subrostrata, Pleurobema catillus,* and the appearance in this area in our observations of *Amygdalonaias donaciformis, Arcidens confragosus, Lampsilis anodontoides, Quadrula verrucosa.*

We obtained no results whatsoever from crowfoot bars in any of the localities of this area at which we had used them in 1920. Comparing the results of collecting by hand from the sandbars in 1920 and 1925, it is found that the shells have increased in absolute abundance and that the commercial species represented by the pimple backs, hickory nuts, blue points, three ridges, and white heel splitters have relatively increased also. A decided loss is recorded for the pigtoes, pocketbooks, and Lake Pepin muckets. In the case of the latter species the region is too far away for propagation work to be felt. Among the non-commercial shells one of the forms of paper shells shows an increase (*Proptera laevissima*) and another, (*Leptoolea fragilis*) a decrease. Juveniles were decidedly more abundant in 1920. The shells most frequently found in the area were pocketbooks, pigtoes and three ridges. It is believed that the further decline in the

absolute abundance of shells in this area is due most largely to the various government activities in the improvement of the river. A leech collected from the clams taken in the vicinity of Island 55 was identified by Professor J. Percy Moore as *Placobdella parasitica*. A rather common spider inhabiting the sandbars in the vicinity of Fountain City, Wis., was determined by Professor Alexander Petrunkevitch of Yale University to be probably *Arctosa littoralis* (Hentz).

AREA IX.

Boundaries, Fountain City, Wis., to Winona, Minn., at high bridge. Status, open to fishery in 1920, closed in 1925. Length in linear miles, 8.6. Physical condition 2 ft. high water, current 4 miles per hour. Bottom gravel and mud, with less amount of riff-raff than in preceding areas. 1925, three feet of low water.

Localities Reported Upon.

A. Results with crowfoot bars.

Loc. IX-2. South end of Island 62, across the mouth of a slough, starting 20 ft. from nearest shore. Aug. 18, 1920. Sept. 9, 1925, drags 20, 40, 75 and 100 feet from Wisconsin shore. After no results, substituted three collecting ½ hr. from sand bars of vicinity.

Loc. IX-22. Straight Slough about 3 miles from mouth, across the mouth of the first slough above island with 655 elevation, 25 ft. from north shore, Aug. 21, 1920. Sept. 10, 1925, 3 collecting by hand from the sand bars of the vicinity.

Loc. IX-31. 800 ft. northwest of the C. M. St. P. R. R. bridge at Winona, 35 ft. from sheer boom, Aug. 23, 1920. Sept. 11, 1925, drags at 25, 40, 60 and 125 ft. from shore.

B. Results picking by hand from sand bars.

Loc. IX-6. Sand bars opposite lower entrance to Pap Slough Aug. 18, 1920. Sept. 9, 1925.

Loc. IX-8. Sandbars in vicinity of north end of Island 65 and 66 on northwest shore. Aug. 18, 1925, Sept. 7, 1925.

Loc. IX-30. Sand bar just north of high bridge at Winona on Wisconsin shore, Aug. 23, 1920. Sept. 11, 1925.

Notes on Area IX.

We did not encounter *Fusconaia ebena* or *Plagiola lineolata* in this area during 1925. We collected for the first time in the area *Quadrula quadrula*, *Lampsilis higginsii* and *Lampsilis anodontoides*. With the exception of one sandbar locality on which there was an enormous increase, shells have declined in absolute abundance in this area during the past five years, both as regards commercial and non-commercial species. As regards relative abundance pimple backs show an increase, as well as blue points. Pocketboooks, strangely enough show an increase in the clam beds proper but a slight decrease is noted in the numbers of these obtained from the sand bars, while white heel splitters increase in both types of localities. Among the non-commercial species, the squaw foot is on the increase in the clam beds as well as one of the paper shells, *Leptodea fragilis*. The latter is also abundant on the sand bars.

Most of the living shells seen in Loc. IX-22 were younger ones, the more prominent species being indicated by the table. On the other hand there were many very large dead bullheads, niggerheads and river muckets. The conditions prevailing in Straight Slough as they concern the mussel resources have been discussed in the remarks on the status of the mussel fisheries in the region surveyed. At our locality IX-30 a sand bar immediately north of the high bridge at Winona, Minn., we observed as in 1920, that many pocketbooks had been cut open for pearls, presumably by the foreign element of the population of Winona.

Propagation carried on in Lake Pepin shows little effect on the distribution of the Lake Pepin mucket. More juveniles of all species were collected from the clam beds and sand bars in 1920 than in 1925. The percentages establish that the principal shells in the area are blue points, pocketbooks, white heel splitters, pimple backs, long johns, pigtoes and hickory nuts. An exquisite red dragon fly observed in Straight Slough was pronounced by Mr. Hugo Kahl to be a male specimen of *Sympetrum rubicundulum*, Say, while masses of algae in the pools behind the sand bars were determined by Professor I. F.

Lewis, Head of the Department of Botany, University of Virginia to be *Hydrodictyon reticulatum* (L.) Lagerheim.

From Betsey slough, near Fountain City, we obtained a specimen of the nymph of the dragonfly, *Gomphus externus* as identified by Dr. Needham.

AREA X.

Boundaries, Winona, Minn., high bridge to La Moille, Minn., Status, closed to fishery in 1920, open in 1925. Length in linear miles 7.2. Physical conditions 2 ft. high water, current 4 miles per hour. Bottom sand and gravel, many snags. In 1925, 3 ft. of low water.

Localities Reported Upon.

A. Results with crowfoot bars.

Loc. X-4. Drags 15-25 ft. from sheer boom, 450 ft. north of Burlington bridge at Winona, off Minnesota shore, Aug. 24, 1920. Sept. 11, 1925, drags 15, 20, 40 and 60 ft. from sheer boom.

Loc. X-6. Above Homer, starting opposite 700 ft. elevation and dragging down to point with 655 elevation, 25 ft. off Minnesota shore, Aug. 25, 1920. Sept. 14, 1925, drags 18, 20, 25 and 40 ft from shore.

Loc. X-9. Starting at point adjacent to Homer to 680 elevation, 25 ft. from shore, Aug. 25, 1920. Sept. 14, 1925. Drags 18, 20, 25, 40 ft. from shore.

B. Picking by hand from sand bars.

Loc. X-7. Sand bar directly opposite Homer, Minn. Aug. 25, 1920. Sept. 12, 1925.

Loc. X-12. Sand bars in vicinity of Island 76. Aug. 26, 1920. Sept. 14, 1925.

Loc. X-14. Sand bars off island 78. Aug. 26, 1920. Sept. 12, 1925.

Notes on Area X.

Our results from this area may be affected by the fact that our locality X-4 was extensively clammed this summer, while Loc. X-6 was worked off and on by 6-8 clammers dur-

ing this period. In addition to the shells we obtained from Loc. X-6 we saw nearly a bucketful of three ridges, buckhorns and river muckets from this locality. Loc. X-9 represents the best instance of the effect of the protective laws which came to our notice although for the reason indicated it is not substantiated by our own data. At the time the area had been closed five years ago, few or no shells existed there, but during the past summer 4 or 5 men worked this locality, one clammer getting five tons out of here at the first of the season, with clams on every hook. Afterwards, they picked by hand with considerable success. This bed is stated to be a very narrow one.

In 1925 we failed to collect the following species in Area X, *Fusconaia ebena, Eurynia subrostrata, Proptera alata.* So far as the clam beds themselves are concerned, the shells show a decrease in absolute abundance and this occurs on the sandbars also. The fact that this area shows a large number of increases in relative abundance than any other area below Lake Pepin may somewhat compensate for this condition. The increases in commercial shells in the clam beds in order of magnitude are hickory nuts, monkey faces, pocketbooks, pimple backs, and long johns. On the sandbars the increases are found to be in the blue points, Lake Pepin muckets and white heel splitters among commercial shells, and the squawfoots and *Anondontas* in the non-commercial group.

Juveniles as a rule were most abundant in 1920. The Lake Pepin mucket was somewhat more abundant in this area than in the preceeding one. A brick red sediment on the banks of the sloughs and ponds in this vicinity was determined by Dr. G. T. Moore to consist of the flagellate genus *Uglena.* Associated with these forms were the green algae *Hydrodictyon reticulatum* (L). Lagerh., *Coelastrum microsporum* Naegeli, *Melosira varians Agardh.* and the diatoms *Navicula* (2 sp.) *Gyrosigma Tenuatum* Kuetz, *Fragillaria* sp. and abundant *Peridinium* sp. These latter were kindly determined by Dr. O. E. Jennings.

VII.—CONCLUSIONS

From the data presented under the heading of each area, the following tabulation is made dealing with the absolute abundance of shells in the areas appraised. For Areas VII, VIII, IX and X the results having their basis on collections from sand bars are expressed in parentheses.

Area and Status as to Fishery	No. Shells—Commercial Species Per Linear Mile 1920	1925	No. Shells—Commercial Species Per Linear Mile 1920	1925	Average All Shells Per Linear Mile 1920	1925
I. Closed	197.1	48.3	66.	15.7	263.1	64.
II. Open	84.1	62.6	47.9	16.	131.5	78.6
III. Closed	39.	26.3	6.61	4.4	44.61	30.7
*IV. Open	92.		10.3		102.3	
*V. Closed	166.8		7.		173.8	
VI. Open	243.25	52.	15.5	2.	258.75	54.
VII. Closed	14.5 (16.13)	3.6 (9.1)	1. (6.55)	*(2.3)	15.5 (22.68)	3.6 (11.4)
VIII. Open	10. (43.)	.3 (46.8)	1.2 (2.8)	*(3.5)	11.2 (45.8)	.3 (50.3)
IX. Closed	28.24 (54.)	7.4 (14.6)	4.76 (7.6)	2.1 (2.2)	33. (61.6)	9.5 (16.8)
X. Open	45.3 (62.91)	18.3 (10.4)	4. (8.3)	1.7 (6.8)	49.3 (71.20)	20. (17.2)

* For data concerning these areas see report of J. B. Southall.

From the preceding tables, it is concluded that under the conditions in which the surveys of 1920 and 1925 were made:

I.—That the fresh water mussels considered as a whole have declined in absolute abundance during the past five years in the regions between Diamond Island, and La Moille, Minn., despite the favoring action of protective laws. This decline is observed for commercial species in areas I, II, III, VI, VII, IX, X and for non-commercial species in areas I, II, III, VI, VII, IX, X. Judged by the results of collecting on sand bars there are slight increases in absolute abundance of both commercial and non-commercial shells in Area VIII, but the yields from crowfoot bars show a distinct loss.

II.—That certain commercial species have come to make up a larger proportion of the Naiad fauna, in the areas considered as a whole during the past five years. Such are *Pleurobema catillus*, (niggerhead), *Quadrula quadrula* (maple leaf), *Obliquaria reflexa* (three horned warty back), *Fusconaia undata*, (pigtoe), *Amblema peruviana*, (blue-point), *Amblema costata*, (three ridge), *Megalonaias heros*, (washboard), *Quadrula verrucosa*, (buckhorn), *Lampsilis anodontoides*, (yellow sand shell), *Lampsilis fallaciosa*, (slough sand shell), *Eurynia recta*, (long john), *Elliptio niger*, (elephant ear), totalling twelve species.

III.—That non-commercial species which have similarly increased are *Anodonta imbecillis*, (paper shell), *Strophitus edentulus*, (squaw foot), *Proptera laevissima*, (paper shell), totalling three species.

IV.—That other commercial species constitute a less proportion of the Naiad fauna in the areas considered in 1925 than they did in 1920. Such are *Fusconaia ebena*, (niggerhead), *Obovaria olivaria*, (hickory nut), *Quadrula pustulosa*, (pimple back), *Quadrula metanevra*, (maple leaf), *Actinonaias carinata*, (river mucket), *Lampsilis higginsii*, (higgins' eye), *Lampsilis siliquoidea*, (Lake Pepin mucket), *Plagiola lineolata*, (butterfly), *Amygdalonaias truncata*, (deer toe), *Lampsilis ventricosa*, (pocketbook), *Lasmigona complanata*, white heel splitter), *Lasmigona costata*, (fluted shell), *Proptera alata*, (pink heel splitter), *Arcidens confragosus*, (rock pock-

etbook), *Elliptio dilatatus,* (spike), *Amygdalonaias donaciformis,* (sugar spoon), totalling sixteen species. In this group are found the most important button making shells.

V.—That non-commercial shells which have similarly decreased are *Anodonta grandis,* (slop bucket), *Anodonta corpulenta,* (paper shell), *Leptodea fragilis,* (paper shell).

VI.—That within the limits of the observations made by the writer's party, the reasons assignable for such a decrease are those discussed most fully in the section of the report dealing with the staus of the mussel fisheries in the areas surveyed, viz., smothering of mussel beds by sand deflected from the dams, destructive fishing methods, stream pollution, lack of a correlating factor in conservation activities.

VIII.—REMARKS AND RECOMMENDATIONS

On the basis of the preceding information it is recommended:

I.—To the United States Engineers, the Game Commissions of the States of Wisconsin and Minnesota through the agency of the U. S. Bureau of Fisheries, that further plans for the improvement of the channel of the Upper Mississippi beyond the developments reached in 1925 be the subject of mutual discussion with the idea of giving the Game Commissions and the Bureau of Fisheries the opportunity to conserve if possible the mussel life which may be imperilled by such improvements.

II.—To the Game Commissions of the State of Minnesota and Wisconsin through the U. S. Bureau of Fisheries, the following is cited as apparently falling in their province for action, viz.,

(a). That effort be made to prevent the increasing degree of stream pollution in the areas studied.*

(b). That restriction of clamming operations be limited to one individual per license.

---

* With regard to this situation, the writer is in receipt of the following letter, Nov. 2, 1925, from the State Board of Health of Wisconsin: "You will probably be interested to know that at a recent meeting of the interim committee of the State of Wisconsin and Min-

(c). That clear interpretation of the protective laws be made as regards the practice of taking clams by hand in closed areas.

(d). That provision be made to guard clams against exceptional stages of low water where this occurs in an area subject to fishery.

(e). That all sloughs below Lake Pepin to La Moille be closed to mussel fishery until that stretch of the river has returned to normal conditions through the agency of engineering improvements, when it may be restocked with shells from these sloughs.

(f). That the recommendations made in the preceding be kept vigorously in force by the game wardens of the states concerned checking up the list of the clammers operating in their vicinity.

III.—Of the United States Bureau of Fisheries it is urged:

(a). That rescue work for mussels on sand and mud bars, in pools back of dams and wherever large numbers of clams are exposed by low water by low water conditions be made a larger part of the program of the fish rescue crews.

(b). That where sites of old clam beds still appear favorable to mussel life, such be restocked with commercial species when in the judgment of the government engineers the river has returned to normal conditions.

(c). That the coöperation of shell buyers be obtained toward standardizing the prices paid for mussel shells in order that there be no incentive leading to violation of the protective laws, and toward rejection of immature and illegally sized shells when presented by inexperienced clammers.

IV.—That the recommendations presented in I and II to the U. S. Engineers and the Game Commissions of Wisconsin and Minnesota have the official support of the U. S. Bureau of Fisheries where such appears to be practicable.

---

nesota, it was planned that a study should be made of the condition of the Mississippi River below the twin cities of St. Paul and Minneapolis with the ultimate object of removing the pollution coming from these two cities."

BOOK REVIEWS

In this section are reviews of new, or particularly important and interesting books in the fields of natural science. Books dealing with botany or kindred subjects should be sent to the Editor, the University of Notre Dame. *All other books for review* should be sent to Carroll Lane Fenton, at the Walker Museum, the University of Chicago, Ill. Publishers are requested to furnish prices with books.

PRINCIPLES OF GENETICS By Sinnott and Dunn. McGraw-Hill Book Co., Price, $3.50.

Genetics belongs to that category of science that is still so young that uniform standards for the treatment of its various subdivisions have not yet been formulated. The particular interest of the author, whether in plants or in animals, is usually apparent from the general content and method of treatment that the various subjects receive throughout the book. The joint authorship of a botanist and a zoologist, therefore, leads us to expect a more balanced presentation of the subject as a whole. This expectation is realized in Principles of Genetics. The presentation is uniformly clear, concise and accurate. The four hundred and seventeen pages of text present the subject in a manner that leaves little to be desired. A feature of the book that is especially desirable is the questions for thought and discussion and the reference assignments at the end of each chapter. There is a good bibliography as well as a complete table of contents and an index. We wonder, just why Mendel was made a Franciscan abbot, as we read on page 8. It ought to be a matter of common knowledge that there are no Franciscan abbots, and that the monastery at Brunn, where Mendel lived and worked, is even to this day in the care of the Augustinians.

—F. W.

The American Midland Naturalist

PUBLISHED BI-MONTHLY BY THE UNIVERSITY OF NOTRE DAME,
NOTRE DAME, INDIANA

VOL. X. NOVEMBER, 1926. No. 6.

INDIANA DUNE PLANT NOTES.

DONALD C. PEATTIE.

In the preparation of a manual of the flora of the Indiana sand dune country at the head of Lake Michigan, some new species and varieties of plants have been discovered, and from a nomenclatorial point of view it is desirable to publish a few combinations. As such taxonomic matters do not find a convenient place in a manual intended for popular use, the new names and combinations are therefore being published first in regular botanical periodicals.

Typha angustifolia L. var. calumetensis Peattie, var. nov. Caulis 0.5-1 m. altus, tenuissimus, foliis 1.5-3 dm. longis, 3-6 mm. latis, saepe involutis; inflorescentia staminea vix 4 mm. in diametro, 7 cm. longa; foeminea 3-10 cm. longa, 3-10 mm. in diametro; rhachis nuda 6 cm. longa.

A remarkable dwarf plant, lower, and extremely slender in all its parts. Growing with *T. latifolia* L., but obviously by its reproductive characters a variety of *T. angustifolia* from which it differs only in vegetative ways. Type specimens in Field Museum, Chicago: Peattie No. 278. Pine, Ind. Aug. 20, 1920; and No. 2340. Marshes of the Grand Calumet at Clarke, Ind., July 28, 1926.

This plant is so suitable for ornamental purposes on account of its dainty growth that it is cut in immense quantities on the marshes of the Grand Calumet every year and is sold in the flower markets in Chicago. It is not, as might be supposed, an immature condition of true *T. angustifolia* L., which has very slender spikes when green. The variety *calu-*

metensis is just as narrow when it goes to seed. Although many varieties of *T. angustifolia* have been described none of them coincide with the specimens cited.

Commelina communis L. var. verticillata Peattie, var. nov. caulibus crassioribus, ramis omnibus verticillatis, foliis late ovatis, acutis, vaginis grandibus scariosisque.

Similar in flowers, spathes and seeds to the typical plant, but the branches all in whorls of 3-5 and the leaves broadly ovate; large ovate-lanceolate papery bracts accompany each verticel.

Type specimens in Field Museum, Chicago: C. W. Duesner, Pine, Oct. 31, 1908.

Rumex altissimus Wood. var. abortivus Peattie, var. nov., singula granularum grandi prominente, aliis plus minusque abortivis.

Precisely similar to the typical plant in vegetative ways, and having similar valves, but only one of the grains large and prominent, the others variably reduced or absent. As traces of all three grains are usually present in this variety it might be thought the specimens representing it were nothing but *R. mexicanus* Meisn., but it is obvious to anyone familiar with the vegetative appearance of *R. altissimus* that var. *abortivus* is but a phase of it.

Type specimens in Field Museum, Chicago. Peattie No. 2350. East Gary, Ind., July 28, 1926.

Gratiola mesochora Peattie, sp. nov. Caulis tenuis, 5-10 cm. altus; corollis flavis; capsulis vel sessillibus, vel vix pedunculatis.

A low-growing plant; leaves only about five pairs, 1.7-3 cm. long, ovate-lanceolate to oblong-ovate, mostly entire or obscurely repand and narrowed to a bluntish tip, rarely somewhat spatulate and toothed at tip; corolla bright yellow throughout, about 7 mm. long; calyx 2-3 mm. long, its teeth deltoid; pod broad, often broader than long, not over 5 mm. long, usually less, sessile or practically so.

Type specimens in Field Museum, Chicago: Umbach. Ponds, Clarke, Ind., Sept. 10, 1898.

This interesting little plant is in reality a close relative of *G. virginiana* L. and *G. sphaerocarpa* Ell., as it has the broad

anther connectives, the diffuse or creeping stems, and the foliaceous bracts, and no sterile filament. Its bright yellow corolla however recalls *G. aurea* Muhl. though it is much shorter. It differs from both *G. virginiana* and *G. sphaerocarpa* in being 1 dm. or less tall, in having an entirely yellow corolla, and nearly sessile fruit.

Helianthus giganteus L. var. microcephalus Peattie. Foliis vix 1.5 cm. latis, integris vel sparse sinuatis, inferne pallidis; caulis tenuis; capitibus parvulis; pedunculis tenuibus, bracteis brevioribus; radiis brevioribus, tenuibus.

Type specimens in U. S. National Herbarium, Washington, D. C., Umbach: Clarke, Sept. 9, 1897.

A plant of most striking dissimilarity from *Helianthus giganteus* in vegetative ways and as regards size, but separable on no important reproductive characters. On the whole the leaves are very much narrower than most of the specimens of *H. giganteus,* and are more sparsely repand-denticulate or even entire; lower surface distinctly paler, and while somewhat scabrous it is much less so than in the true species; stem more slender and more sparsely hairy instead of abundantly strigose. The heads are much smaller, on slender peduncles, the bracts shorter, possibly somewhat less ciliate than in most specimens of the true species, and narrower and shorter as are the rays.

A few new combinations are unavoidable, and it is therefore desired to publish the following:

Persicaria mitis Gilib. var. ruderalis (Salisb.) Peattie. comb. nov. If the generic name *Persicaria* is to be taken up for one group of the species comprised in the wider genus Polygonum, and it has seemed expedient to do so in the preparation of this flora, then the name of the familiar lady's thumb, *Polygonum Persicaria* L. Sp. Pl. 361. 1753, so abundantly naturalized from Europe, must be *Persicaria mitis Gilib.* Exerct. Phyt. 2: 431, 1792. This is necessary, by the International Rules, in order to avoid the duplicate binomial, *Persicaria Persicaria* (L.) Small Fl. S. E., U. S., 378, 1903. Salisbury's *Polygonum ruderale* (Prodr. 259, 1796) has been made a variety of *Polygonum Persicaria* L. (Meisn. in DC. Prodr. 14: 118, 1856), and is now transferred as the rules

require to a variety of *Persicaria mitis*. It has prostrate or slightly ascending stems, with frequently appressed-pubescent leaves.

Persicaria punctata (Ell.) Small. var. leptostachya (Meisn.) Peattie. comb. nov. *Polygonum acre* Lam. var. *leptostachyum* Meisn, in DC. Prodr. 14: 108, 1856. *Polygonum punctatum* Ell. var. *leptostachyum* (Meisn.) Small Bull. Torr. Bot. Club, 19: 356, 1892.

Liatris scariosa Willd. var. Deamii (Lunell) Peattie comb. nov. *Lacinaria Deamii* Lunell. Am. Mid. Nat. 2: 169, 1912.

Ribes americana Mill. var. mesochora (Nieuwland) Peattie comb. nov. *Coreosma americana* (Mill.) Nieuwland var. *mesochora* Nieuwland Am. Mid. Nat. 4: 60, 1915.

Lee Heights,
Rosslyn, Va.

NOTES ON TREES AND SHRUBS OF MISSOURI.

BY BENJAMIN FRANKLIN BUSH.

It is now nearly or quite forty years since Tracy published his Flora of Missouri,* in which were recorded a great many species of trees and shrubs for the State. This Flora of Tracy's was largely a compilation of the lists, reports, citations, collections and notes of other collectors and writers, all amateurs in the study of plants, or inexperienced observers, or those unfamiliar with the Flora of the State.

The consequences of these uncertain records of Tracy's were that quite a number of species of trees and shrubs, as well as herbaceous plants, were listed as Missouri species, being based on misidentifications, wrong labels, or gross negligence in making up of lists, or on indefinite citing of localities where specimens were collected.

A few species recorded by Tracy in his Flora rested upon publications and collections of half or three-quarters of a century before, when the limits of the State were but little understood, and when collectors were prone to label their collections "Saint Louis," or "Missouri," when in reality they were collected in Arkansas, Louisiana or Montana.

The sources from which Tracy drew his material for his Flora may be arbitrarily divided into two classes, those before and up to the year 1880, and those after 1880, and up to the year 1885. There are in the first class such collectors and writers as Geyer, Pech, Engelmann, Swallow, Broadhead and Torrey and Gray. In the second class are found Murtfeldt, Shepard, Wirick, Tracy, Galloway, Kellogg and Bush. The following list is arranged in accordance with the arrangement of the families in Tracy's Flora, and a few other species are included in it that were not known to Tracy at the time he prepared his Flora, or had not been cited or

---

Tracy, S. M., Catalogue of the Phaenogamous and Vascular Cryptogamous Plants of Missouri, 1886.

recorded for Missouri at that time, that the list may be as much up to date as possible.

1. MAGNOLIA GLAUCA Linnaeus. SWEET BAY.

Recorded for Missouri by Tracy on authority of Torrey and Gray, who cited this species for Missouri in their Flora of North America, which evidently was based on specimens collected much south of this State. Prior to the publication of Torrey and Gray's Flora, many of the early collectors were very indefinite in the labeling of their specimens, and no doubt through a misleading label some collection was credited to Missouri that was collected south of the present State line.

As Arkansas was a part of Missouri from 1812 to 1819, the specimens upon which this citation rested, must probably have been collected during that period. Torrey and Gray cite a number of other species of plants for Missouri, that are not known to occur in the State, among which are *Potentilla arguta, Prunus pumila, Lepidium ruderale, Artemisia frigida* and *Gaillardia aristata.*

2. HYPERICUM ADPRESSUM Barton. ST. JOHN'S-WORT.

Cited for Missouri by Britton in Manual.

Cited for Missouri by Britton & Brown in Illustrated Flora.

Recorded for Jackson and Henry Counties by Tracy on authority of Bush, but the writer at that time was not able to determine specifically such species as this, that are closely related to other species, and the determination was based on collections of *H. cistifolium.*

At the time the writer furnished Tracy with his notes on Missouri plants, he knew about as little about the Flora of Missouri as any of the other collectors, and he reported to Tracy, amongst others, the following: *Pirus angustifolia, Viola primulaefolia, Spiraea salicifolia, Desmodium rigidum, Crataegus punctata, Galium latifolium, Amelanchier canadensis alnifolia, Ludwigia alata, Cornus stolonifera, Nasturtium palustre hispidum, Solidago Shortii, Aster Shortii, Aster tenuifolius, Eupatorium aromaticum, Heliopsis gracilis, Rudbeckia bicolor, Helianthus strumosus, Scutellaria pilosa, Salix*

lucida, Salix petiolaris, Populus grandidentata, Lilium carolinianum, Hydrophyllum macrophyllum, Cyperus compressus, Scirpus Torreyi, Lepidium ruderale, Elymus Sitanion, Rosa nitida, Carex acutiformis, Carex echinata, Carex striata, Carex Vaseyi and *Potentilla supina*, all of which were based on misidentifications on my part.

Recorded for Saint Louis County by Tracy on authority of Kellogg, and probably based on specimens of *H. cistifolium*, as Kellogg was too inexperienced in the determination of species to be able to separate these. Kellogg also reported to Tracy for Missouri, *Plantago patagonica*, a species not accepted for the State now.

3. HYPERIUM AUREUM Barton. ST. JOHN'S-WORT.

Recorded for Pike County by Tracy on authority of Pech, but evidently an error on the part of Pech in cataloguing. Pech collected in Missouri about Louisiana and Potosi during 1841 and 1842, but his Catalogue of Plants was not published until about 1867. In this catalogue are also included species collected in Indiana, and it is probable that some of these Indiana plants were accidentally listed for Louisiana, Missouri. Amongst others, Pech lists in his Catalogue for Missouri such species as follows: *Nasturtium lacustre, Nasturtium sylvestre, Viola canadensis, Viola canina sylvestris, Viola hastata, Viola cucullata cordata, Hypericum ellipticum, Psoralea canescens, Desmodium rigidum, Lathyrus maritimus, Rubus cuneifolius, Geum rivale, Crataegus punctata, Lechea minor, Lechea thymifolia, Ludvigia linearis, Angelica Curtisii, Archangelica Gmelini, Oldenlandia glomerata, Liatris dubia, Cacalia suaveolens, Aster grandiflorus, Aster Shortii, Helianthus decapetalus, Helianthus giganteus, Coreopsis discoidea, Geranium dissectum, Prenanthes crepidinea, Phacelia fimbriata, Phlox reptans, Senecio tomentosus, Eriophorum gracile. Carex intumescens, Carex novae-angliae, Carex Tuckermani, Carex eburnea, Carex conoidea, Carex aristata, Carex arida, Carex siccata, Carex Willdenovii, Carex bromoides, Carex filiformis, Artemisia canadensis, Myosotis arvensis, Scutellaria nervosa, Leonurus Marrubiastrum, Coreopsis trichosperma, Zannichellia palustris, Cypernus dentatus, Mil-*

lium effusum and Scirpus polyphyllus, all unknown species to the Missouri Flora as understood today.

4. HYPERICUM DENSIFLORUM Pursh. ST. JOHN'S-WORT.

Recorded for Missouri by Small in Flora, citation probably based on my No. 282, collected in low sandy woods at Pleasant Grove, Missouri, and determined by me as *H. densiflorum*. A careful examination of these specimens should disclose their identity with this species, or to the recently described species, *H. oklahomense*.

5. HYPERICUM NUDIFLORUM Michaux. ST. JOHN'S-WORT.

Recorded for Greene County by Tracy on authority of Shepard, but undoubtedly an error in determination. Shepard was more a geologist than botanist, and he was not well acquainted with the Flora of Missouri, and amongst other species, he reported for Missouri the following: *Geranium Robertianum, Hypericum canadense, Sedum stenopetalum, Lechea minor, Astragalus plattensis, Fragaria vesca, Potentilla argentea, Phlox amoena Amelanchier canadensis oblongifolia, Oldenlandia glomerata, Hydrangea radiata, Aster junceus, Nasturtium lacustre, Pycnanthemum leptodon, Pedicularis lanceolata* and *Vaccinium corybosum*, species that are not known now for Missouri.

6. ILEX LAEVIGATA A. Gray. SMOOTH WINTERBERRY.

Recorded for Missouri by Tracy on authority of Swallow, but Swallow undoubtedly made a mistake in determination. This reference was probably from some one of Swallow's Geological Reports, as Swallow was a geologist and knew but very little about trees and shrubs. That Swallow was not very well acquainted with species of plants is shown in his report for Missouri the following: *Ilex verticillata, Spiraea betulifolia, Crataegus flava, Oenothera glauca, Bartonia tenella, Breweria aquatica, Castanea vulgaris Americana, Alnus incana, Asclepias paupercula, Quereus cinerea, Limnobium Spongia, Veratrum parviflorum, Smilax tannifolia* and *Smilax glauca*, all of which are unknown for Missouri at this time.

7. AESCULUS FLAVA Aiton. YELLOW SWEET BUCKEYE.

Recorded for Missouri on his own authority, who says it is common in the State, but he must have had *Ae. glabra* in mind when he wrote that. Tracy did not have much of an idea of the Flora of Missouri, for he cites as Missouri species the following: *Sisymbrium Thaliana, Anemone nemorosa, Rhus typhina, Viola primulaefolia, Viola cucullata cordata, Rubus strigosus, Rubus trivialis, Rosa blanda, Rosa lucida, Pirus angustifolia, Cerastium oblongifolium, Crataegus coccinea, Crataegus Crus-galli, Crataegus flava, Crataegus punctata, Uvularia perfoliata, Ribes aureum, Ribes rotundifolium, Oenothera fruticosa linearis, Conioselinum canadense, Veratrum viride, Cornus circinata, Viburnum dentatum, Viburnum Lantanoides, Plantago heterophylla, Spiraea salicifolia, Fragaria virginiana, Galium latifolium, Lycopodium dendroideum, Chenopodium capitatum, Artemisia vulgaris, Coreopsis trichosperma, Senecio vulgaris, Lonicera flava, Urtica dioica, Helianthus doronicoides, Viola rotundifolia, Viola cucullata, Viola cucullata palmata, Quercus coccinea, Phlox maculata, Vincetoxicum nigrum, Phlox reptans, Heliopsis laevis, Vaccinium pennsylvanicum, Betula alba populifolia, Populus grandidentata, Lilium philadelphicum, Tradescantia rosea, Orontium aquaticum, Agostis elata, Andropogon dissitiflorus, Lilium Catesbaei, Equisetum hyemale, Aspidium Lonchitis* and *Aristida purpurea*, all species not known to occur in the State.

Tracy's collection is in all probability at the State University at Columbia, Missouri, and an examination of the specimens should show just what it was that Tracy collected.

8. ACER PENNSYLVANICUM LINNAEUS. STRIPED MAPLE.

Recorded from Iron County by Tracy on authority of Galloway, but Galloway made many mistakes in his determinations, as is shown by the following list: *Draba verna, Agrostis elata, Stellaria borealis, Smilax tamnoides, Callirrhoe triangulata, Poa brevifolia, Poa nemoralis, Viola hastata, Hypericum angulosum, Plantago patagonica, Lupinus perennis, Aristolochia Sipho, Oenothera, riparia, Hydrolea quadrivalvis, Cornus stolonifora, Liatris elegans, Pirus angustifolia,*

Valerianella chenopodifolia, Solidago bicolor, Phlox procumbens, Aster undulatus, Gnaphalium decurrens, Iva frutescens, Deschampsia caespitosa, Chionanthus virginica, Pellaea gracilis and *Stipa avenacea,* all of which are unknown to the writer as Missouri species at this time.

Galloway made a large collection of plants in Mississippi County, and these were mainly determined by Tracy, and these specimens should be in the Herbarium of the University of Missouri, at Columbia, and an examination of this collection will throw some light on Tracy's determinations.

9. RHUS TYPHINA Linnaeus. STAGHORN SUMAC.

Recorded as common in Missouri by Tracy on his own authority, but no specimens of this species are known from Missouri, and Tracy's determinations were probably based on *R. copallina,* which is commonly mistaken for *R. typhina.*

Cited for Missouri by Britton in Manual, evidently copied from some earlier record, probably Tracy's.

10. RHUS VENENATA D. POISON SUMAC.

Recorded for Greene County by Tracy on authority of Shepard, but this must have been a mistake, as no one else has seen this species in Missouri, and recent collections all around Greene County have failed to reveal this species.

Cited for Missouri by Britton in Manual.

Cited for Missouri by Britton & Brown in Illustrated Flora.

The two citations above must have been copied from some earlier record, probably Tracy's.

11. PRUNUS PENNSYLVANICA Linnaeus. WILD RED CHERRY.

Recorded for Adair County by Tracy on authority of Broadhead, but Broadhead was a geologist and had but little knowledge of the Missouri Flora, he having reported for Missouri the following: *Anemone parviflora, Anemone decapetala, Anemone nemorosa, Vesicaria Shortii, Delphinium exaltatum, Polygala Nuttallii, Arenaria stricta, Geum macrophyllum, Gaylussacia dumosa, Salix candida, Amaranthus Blitum, Hieracium canadense, Coreopsis gladiata, Galium asprellum, Phlox ambena, Lobelia Kalmii, Lechea minor, Pel-*

laea gracilis, Gentiana angustifolia, Opuntia missouriensis, Linum Boottii, Hibiscus Moscheutos, Viola lanceolata, Viola canina sylvestris, Baptisia alba, Hypericum graveolens, Pirus arbutifolia, Conioselinum canadense, Viburnum lantanoides, Lonicera hirsuta, Liatris elegans, Aster reticulatus, Helianthus angustifolius, Pyrrhopappus scaposus, Vaccinium corymbosum, Leucothoe racemosa, Arctostaphylos Uva-Ursi, Rhododendron nudiflorum, Phlox reptans, Lilium Catesbaei, Tradescantia rosea, Botrychium matricariaefolium, Aspidium Lonchitis, Scirpus polyphyllus, Botrychium ternatum, Andropogon macrourus, Veratrum parviflorum and *Juncus setaceus*, all species that are now not regarded as Missouri plants.

Recorded for Pike County by Tracy on authority of Pech, but undoubtedly a mistake in labeling.

Recorded for Saint Louis County, by Tracy on authority of Murtfeldt, but Miss Murtfeldt was more an entomologist than botanist, and did not know the Missouri plants as well as she did the insects, as the following list will show: *Anemone nemorosa, Opuntia vulgaris, Ranunculus pennsylvanicus, Lupinus perennis, Viburnum Opulus, Aster longifolius, Aster tenuifolius, Pluchea camphorata, Lysimachia stricta, Deschampsia flexuosa* and *Schweinitzia odorata*, all quite unknown to the writer as Missouri plants.

12. PRUNUS PUMILA Linnaeus. SAND CHERRY.

Recorded for Missouri by Tracy on authority of Torrey and Gray in Flora of North America, but evidently the reference in Torrey and Gray was based on some specimen collected much farther north of Missouri.

13. PRUNUS UMBELLATA Elliott. SLOE.

Recorded for Miller County on authority of Wirick, but Wirick was merely an amateur in Botany, and never progressed beyond that stage, and he reported the plants of Miller County to the writer about 1883. In his list of Miller County species are the following: *Viola rostrata, Ranunculus muricatus, Delphinium exaltatum, Baptisia alba, Crataegus coccinea viridis, Heliopsis laevis, Bumelia tenax, Scutellaria saxatilis, Callicarpa americana, Calamintha glabella, Asclepias viridula, Anantherix connivens, Phlox amoena, Tofieldia*

glabra, Gaylussacia resinosa, Lepidium ruderale and *Aspidium Lonchitis*, all unknown to the writer at the present time as Missouri species.

Tracy also records *Prunus virginiana* as common in Missouri, but yet only a few collectors have ever seen this species in the State, and it only occurs in one or two tiers of counties along the northern boundary.

14. SPIRAEA BETULIFOLIA Pallas. SPIRAEA.

Recorded for Putnam County by Tracy on authority of Swallow, but no doubt based on specimens of some other species, probably *Opulaster*. For remarks on this collector's ability to distinguish species of plants, see *Ilex laevigata*.

15. SPIRAEA SALICIFOLIA Linnaeus. MEADOW-SWEET.

Recorded for Jackson County by Tracy on authority of Bush, but this was a mistake. The plants were recognized and identified by Mr. Mann, who claimed he knew the species in New York, and the writer was with him when the plants were found at Lake City.

Cited for Missouri by Britton in Manual.

Cited for Missouri by Robinson and Fernald in Manual.

Cited for Missouri by Britton & Brown in Illustrated Flora.

Cited for Missouri by Small in Flora.

In some way the citation to Missouri got started, and every author copied it until it got to be pretty firmly fixed in the books, but there are no specimens to support these citations.

16: RUBUS CUNEIFOLIUS Pursh. SAND BLACKBERRY.

Recorded for Pike County by Tracy on authority of Pech, but Pech must undoubtedly have misidentified his specimen if collected in Pike County, or he must have collected them elsewhere. As the Pech collection is now lost, it is impossible to determine just what species his specimens really were.

Cited for Missouri by Robinson and Fernald in Manual.

Cited for Missouri by Britton in Manual.

Cited for Missouri by Britton & Brown in Illustrated Flora.

Cited for Missouri by Small in Flora.

It is rather curious how all these citations could have been given, when there are no specimens upon which to base them, but evidently each author copied after the others.

17. RUBUS VILLOSUS FRONDOSUS Torrey. BLACKBERRY.

Recorded from Jackson County by Tracy on authority of Bush, but at that time the writer knew scarcely anything about the species of *Rubus*, and consequently erred in making the determination. No doubt based on what is known as *R. alumnus* Bailey.

18. RUBUS STRIGOSUS Michaux. WILD RED RASPBERRY.

Recorded by Tracy as common in Missouri on his own authority, but no specimens are known of this species from Missouri, although it is probable that it does occur in the extreme northern part of the State, and it is reported to occur near Maryville, Missouri.

19. RUBUS TRIVIALIS Michaux. RUNNING BLACKBERRY.

Recorded by Tracy as common in Missouri on his own authority but it is impossible now to tell which one of the procumbent species Tracy had in hand, unless his specimens are still in some collection.

20. ROSA BLANDA Aiton. SMOOTH WILD ROSE.

Recorded by Tracy as common in Missouri on his own authority, but Tracy knew very little about the Roses at the time he wrote his Flora, and the species he had in mind was probably some one of the *Cinnamomeae*, several species of which are common in many places in the State.

Cited for Missouri by Britton & Brown in Illustrated Flora.

Cited for Missouri by Robinson and Fernald in Manual.

There are no specimens in the Gray Herbarium to support this citation, but there is a specimen from Jackson County, collected by Broadhead in 1864, which I have not seen, and which must be either *R. Bushii* or *heliophila*, as these are common where Broadhead collected in Jackson County, and they cannot possibly be *R. blanda*.

Quite recently this species has been found in Clark Coun-

ty, at Dumas, along the bluffs of the Des Moines River, by Mr. Palmer and myself.

21. ROSA LUCIDA Ehrhart. WILD ROSE.

Recorded by Tracy as common in Missouri on his own authority, and no doubt based on specimens of *R. carolina* L., as now understood, a species not given by Tracy in his Flora.

Tracy also records *R. carolina* (i. e. *R. palustris*) for Boone County, but Boone County is far out of the range of the swamp rose, which is only found in the lowlands of the southeastern part of the State.

22. ROSA NITIDA Willdenow. WILD ROSE.

Recorded by Tracy for Jackson County on authority of Bush, but at the time the writer made that determination no one knew much about the North American species of *Rosa*.

23. ROSA WOODSII Lindley. WILD ROSE.

Cited for Missouri by Britton in Manual.

Cited for Missouri by Robinson and Fernald in Manual.

Cited for Missouri by Britton & Brown in Illustrated Flora.

Cited for Missouri by Small in Flora.

No specimens are known upon which the citations above are based, and as the range of this species is far to the north and northwest, these citations are all erroneous.

24. PIRUS ANGUSTIFOLIA Aiton. NARROW-LEAVED CRAB APPLE.

Recorded for Jackson County by Tracy on authority of Bush, but this is what is now known as *Malus lancifolia* Rehder.

Recorded for Saint Louis County by Tracy on his own authority, but no means are at hand now to tell just what Tracy's specimens really represented.

Recorded from Mississippi County by Tracy on authority of Galloway, and if Galloway's specimens are ever found it may be possible to determine the species they belong to.

Recorded for Missouri by Eggleston in Deam's Trees of Indiana, but I can scarcely believe that the real *Malus augustifolia* ever gets up into Missouri.

25. PIRUS ARBUTIFOLIA Linnaeus. CHOKEBERRY.

Recorded for Holt County by Tracy on authority of Broadhead, but Broadhead must have confused the Choke Cherry with this species when he wrote that.

26. PIRUS CORONARIA Linnaeus. CRAB APPLE.

Cited for Missouri in Britton & Brown's Illustrated Flora, but evidently an error in determination, as no specimens of *Malus fragrans*, the *M. coronaria* of the Illustrated Flora, have been seen from Missouri.

Recorded as common in Missouri by Tracy on his own authority, and I venture the guess that his specimens must have been what we now recognize as *M. ioensis* (Wood) Britton.

27. MALUS FRAGRANS Rehder. CRAB APPLE

Recorded for Missouri by Eggleston in Deam's Trees of Indiana, but no specimens are known from the State by the writer. Eggleston now regards this the same as what has been called *M. coronaria*, and the same as *M. glaucescens*.

28. MALUS GLAUCESCENS Rehder. CRAB APPLE.

Recorded for Missouri by Eggleston in Deam's Trees of Indiana, but Eggleston certainly did not know this species, as he refers to it the following: Courtney, *Bush* 3869, April 29, 1906, and Monteer, *Bush* 6518, October 20, 1911. The Courtney specimens cited above are the type collection of *M. lancifolia* Rehder, and the Monteer specimens cited are the co-type collection of *M. ioensis Bushii* Rehder, two entirely different species.

29. CRATAEGUS AMABILIS Ashe. RED HAW.

Recorded for Missouri by Ashe, and his type specimens were from Keokuk, Iowa. No one seems to know what this species is, although Ashe says it is a *mollis* species, and that it has the leaves rounded or even cuneate at the base. If rediscovered, this tree might look more distinct in the field than the description would imply.

30. CRATAEGUS BELLICA Sargent. RED HAW.

Recorded for Missouri by Palmer in the Bulletin of the

Arnold Arboretum, but no specimens are cited. This species is included in this list merely to call attention to the record of its occurrence.

31. CRATAEGUS BERBERIFOLIA T. & G. RED HAW.

Cited for Missouri by Eggleston in Britton & Brown's Illustrated Flora, who reduces *C. Engelmanni* to synonymy and the same species, and Eggleston evidently refers to *C. Engelmanni* when he cites Missouri as part of the range of *C. berberifolia.*

32. CRATAEGUS BILTMOREANA Beadle. RED HAW.

Cited for Missouri by Britton in Manual.

Cited for Missouri by Eggleston in the Robinson and Fernald Manual.

Cited for Missouri by Eggleston in Britton & Brown's Illustrated Flora.

Eggleston has referred specimens collected by me to this species, which he says is the same as *C. intricata,* but even at that, *C. intricata* Lange, has not been found in Missouri as far as I know.

33. CRATAEGUS CALPODENDRON (Ehrh.) Medicus. RED HAW.

Cited for Missouri by Eggleston in Britton & Brown's Illustrated Flora.

Recorded for Missouri in Dean's Trees of Indiana by Eggleston.

Eggleston says this is the same as *C. tomentosa* L., of Sargent, but *C. tomentosa* L. is a tree-form, and therefore *C. Calpodendron* should be a tree-form, and as such would have been recognized by Sargent in his Manual.

Eggleston has referred specimens collected by me, and also Riehl, Eggert, Engelmann, Haase, Kellogg and Glatfelter, to this species, and has also referred the same specimens of mine to *C. tomentosa Chapmani.* I have no knowledge of *C. tomentosa* or *C. Chapmani* in Missouri.

34. CRATAEGUS COCCINEA Linnaeus. SCARLET HAW.

Recorded as common in Missouri by Tracy on his own authority, but the real *C. coccinea* has never been collected in the State.

The range of *C. coccinea* as given in Britton's Manual, 1905, included Missouri, but evidently that is an error.

Recorded for Miller County by Tracy on authority of Wirick, but it is impossible to tell what species Wirick had in hand. Tracy did not know that *C. coccinea viridis* T. & G., was only a synonym for *C. coccinea*, and he did not know the species of *Crataegus* at all. He records *C. spathulata* for Boone County on his own authority, and certainly erroneously. He records the same species for Miller County on authority of Wirick, but Wirick was also mistaken in his determination. He also records the same species for Saint Charles County, on authority of Broadhead, but some other species was mistaken by Broadhead for *C. spathulata*, and it is needless to say that all these records of *C. spathulata* for Missouri are erroneous.

35. CRATAEGUS COLLINA Chapman. RED HAW.

Cited for Missouri by Britton in Manual.

Cited for Missouri by Eggleston in Britton & Brown's Illustrated Flora.

Recorded for Missouri by Eggleston in Deam's Trees of Indiana.

Eggleston had referred specimens collected by me to this species, but it is very doubtful if this species gets up into this State.

36. CRATAEGUS CRUS-GALLI Linnaeus. COCKSPUR THORN.

Recorded as common in Missouri by Tracy on his own authority, but Tracy never knew what *C. crus-galli* really was. It may be that this species, so long sought after in this State, may occur in the extreme northeastern part of the State, and it may be that some one or more forms having pink or red anthers may really be *C. crus-galli*. Much field-work and more extensive collections in the Crus-galli group will be necessary to establish the fact of the occurrence of this species in the State.

37. CRATAEGUS DENARIA Beadle. RED HAW.

Cited for Missouri by Eggleston in Britton & Brown's Illustrated Flora.

Eggleston refers Davis 195, October 10, 1909, Clarksville, to this species, but this is certainly a mistake.

Eggleston refers *C. Palmeri* to *C. denaria* Beadle, and evidently the Missouri reference above is based on *C. Palmeri*, but Davis 195 is not *C. Palmeri*.

38. CRATAEGUS DEPRESSA Ashe. RED HAW.

Cited for Jackson County, Missouri, by Ashe in the Elisha Mitchell Journal. Type specimens were collected in northeastern Missouri, but Ashe erroneously referred specimens of *C. Mackenzii* to this species.

Eggleston has referred this to *C. pruinosa*, and *C. Mackenzii* also, but it is very doubtful if *C. pruinosa* has been found in Missouri.

39. CRATAEGUS DILATATA Sargent. RED HAW.

Cited for Missouri by Eggleston in the Robinson and Fernald Manual.

Eggleston has referred *C. speciosa* to *dilatata*, but is very doubtful if the real *C. dilatata* occurs in Missouri and the citations above must refer to *C. speciosa*.

40. CRATAEGUS FLAVA Ait. SUMMER HAW.

Recorded for Putnam County by Tracy on authority of Swallow, but certainly a mistake in determination.

Recorded for Boone County by Tracy on his own authority, and also a mistake in determination.

Cited for Missouri by Britton in Manual, but this is a mistake, as Missouri is entirely beyond the range of this species.

41. CRATAEGUS INTRICATA Lange. RED HAW.

Cited for Missouri by Eggleston in Britton & Brown's Illustrated Flora, but no specimens of the real *C. intricata* are known from the State, and I am unable to say what species Eggleston had in mind when he wrote that.

42. CRATAEGUS MACRACANTHA (Lindl.) Lodd. RED HAW.

Cited for Missouri by Britton in Manual, but no specimens known to substantiate this citation.

Specimens recently collected north of Dumas, Missouri,

near the Iowa line, on the Des Moines River, have been determined as this species, but they may not be.

43. CRATAEGUS OBESA Ashe. RED HAW.

Cited for Missouri by Ashe, but nothing is known of this species beyond what the describer has given us.

44. CRATAEGUS PRATENSIS Sargent. RED HAW.

Cited for Missouri by Eggleston in the Robinson and Fernald Manual.

Eggleston refers *C. Palmeri* and *C. denaria* both to this species, and it is probable that the citation above refers to *C. Palmeri*, but it is very doubtful if the real *C. pratensis* has ever been found in Missouri.

45. CRATAEGUS PRUINOSA (Wendl.) K. Koch. RED HAW.

Cited for Missouri by Britton in Manual.

Cited for Missouri by Eggleston in the Robinson and Fernald Manual.

Cited for Missouri by Eggleston in Britton & Brown's Illustrated Flora.

Recorded for Missouri by Eggleston in Deam's Trees of Indiana.

Eggleston says this species under various synonyms occurs throughout Missouri, but I doubt very much if the real *C. pruinosa* has ever been collected in Missouri.

46. CRATAEGUS PRUNIFOLIA (Marsh.) Pers. RED HAW.

Cited for Missouri by Britton in Manual, but it is very likely that this is only a synonym of *C. crus-galli* L.

As to the occurrence in Missouri of *C. crus-galli*, see remarks under the species.

47. CRATAEGUS PUNCTATA Jacq. RED HAW.

Recorded for Boone County by Tracy on his own authority, but that certainly was a mistake, for this species has not yet been found in the State.

Recorded for Jackson County by Tracy on authority of Bush, but that also was a misidentification.

Recorded for Pike County by Tracy on authority of Pech,

but Pech must have mistaken some other species for this, and *C. punctata* is still a desideratum for Missouri.

It may possibly occur in extreme northeastern Missouri.

48. CRATAEGUS REVERCHONI Sargent. RED HAW.

Cited for Missouri by Eggleston in Britton & Brown's Illustrated Flora.

Eggleston refers *C. rubrisepala, C. rubrifolia* and *C. jasperensis* to this species, and it is one or the other that is referred to in the citation. If *C. Reverchoni* is to be kept distinct, it is not found in Missouri.

49. CRATAEGUS STRAMINEA Beadle. RED HAW.

Cited for Missouri by Eggleston in Britton & Brown's Illustrated Flora, but no specimens are known upon which to base this citation.

Eggleston says that *C. intricata* Sargent, and *C. apposita* Sargent, are synonyms of this, but neither of these has been found in Missouri.

50. CRATAEGUS TOMENTOSA L. RED HAW.

Cited for Missouri by Britton in Manual.

Cited for Missouri by Small in Flora.

Eggleston says this is the same as *C. Calpodendron,* but even at that *C. Calpodendron* has not been collected in the State.

51. CRATAEGUS UNIFLORA Muench. RED HAW.

Cited for Missouri by Britton in Manual.

Cited for Missouri by Eggleston in the Robinson and Fernald Manual.

Cited for Missouri by Eggleston in Britton & Brown's Illustrated Flora.

It is evident that all these citations refer to *C. triantho-phora* Sargent, as Eggleston regards this the same as *C. uniflora,* but no specimens of the real *C. uniflora* have been collected in the State.

52. CRATAEGUS VAILIAE Britton. RED HAW.

Cited for Missouri by Britton in Manual.

Cited for Missouri by Eggleston in Britton & Brown's Illustrated Flora.

Eggleston considers *C. missouriensis* the same as *C. Vailiae*, but I do not think this view is tenable, and the citation above must be based on *C. missouriensis*.

53. CRATAEGUS VERNA Ashe. RED HAW.

Cited for Missouri by Ashe, but no one seems to know what this species is. If it is a valid species it ought to be found in extreme northeastern Missouri.

54. CRATAEGUS VESCA Ashe. RED HAW.

Cited by Ashe for Missouri, but no one seems to know what this species is. It is a *mollis* species, with very small round leaves and globose fruit. It ought to be found along the Des Moines River in Clark County.

55. AMELANCHIER CANADENSIS ALNIFOLIA Gray. JUNE-BERRY.

Recorded for Jackson County by Tracy on authority of Bush, but this was an error, as the shrubs upon which the identification was based proved to be cultivated plants, as afterwards ascertained.

56. AMELANCHIER CANADENSIS OBLONGIFOLIA Gray. JUNE-BERRY.

Recorded for Greene County by Tracy on authority of Shepard, but evidently an error in identification, as no specimens of this species are known from the State.

Cited for Missouri by Eggleston in the Robinson and Fernald Manual, but no specimens are known to support this citation.

Several specimens collected by Palmer and myself have been referred to this species, but they undoubtedly are only *C. Canadensis*.

57. AMELANCHIER LAEVIS Wiegand. JUNE-BERRY.

Cited for Missouri by Wiegand in Rhodora.

Recorded for Missouri by Eggleston in Deam's Trees of Indiana.

No specimens have been seen by me of this species, but

it is not unlikely that it occurs in extreme northeastern Missouri, as it is cited by both Wiegand and Eggleston.

58. HYDRANGEA RADIATA Walter. HYDRANGEA

Recorded for Greene County by Tracy on authority of Shepard, but this surely must have been *H. arborescens*, as no specimens of *H. radiata* have been seen from Missouri.

59. HYDRANGEA ARBORESCENS DEAMII St. John. HYDRANGEA.

Recorded for Missouri by Deam in Shrubs of Indiana.

This newly-described variety is said to differ from the typical form in having the under surface of the leaves densely pubescent. I am inclined to believe this is a mere form of the species, not worthy of recognition.

60. HYDRANGEA ARBORESCENS OBLONGATA T.&G. HYDRANGEA.

Recorded for Missouri by Deam in Shrubs of Indiana, but this must be a mere leaf-form, not worthy of recognition as a variety.

61. RIBES AUREUM Pursh. BUFFALO CURRANT.

Recorded as common in Missouri by Tracy on his own authority, and it is not common in rocky woodlands as stated by Tracy, nor did Tracy ever see it in Missouri unless the shrubs were cultivated.

Cited for Missouri by Britton in Manual, evidently based on some earlier report, probably Tracy's.

Cited for Missouri by Robinson and Fernald in Manual, evidently copied from some earlier authority.

The two citations above evidently refer to *R. odoratum*, the only yellow-flowered *Ribes* in the State. This species occurs along rocky bluffs of the White River, near Swan and along the high bluffs of the same stream at Forsyth, but there only recently discovered, and it is very probable that the White River species is undescribed.

62. RIBES ROTUNDIFOLIUM Michx. GOOSEBERRY.

Recorded as common everywhere in Missouri by Tracy on his own authority, but Tracy was certainly mistaken in this, as no specimens of this species are known from the State.

63. CORNUS CIRCINATA L'Her. ROUND-LEAVED DOGWOOD.

Recorded as common on the bluffs of Eastern Missouri by Tracy on his own authority, but as Tracy does not record *C. alternifolia* which does grow on bluffs in Eastern Missouri, it is probable that this is what Tracy found.

64. CORNUS STOLONIFERA Michx. RED DOGWOOD.

Recorded from Johnson County by Tracy on authority of Bush, but this was a mistake in determination by me, as the specimen proved to be *C. obliqua* Raf.

Recorded for MississippiCounty by Tracy on authority of Galloway, and certainly an error, as no specimens of this species are known from the State by the writer.

65. VIBURNUM DENTATUM L. ARROW-WOOD.

Recorded as common in Missouri by Tracy on his own authority, but no specimens are known to the writer from the State, and it is probable that specimens of what has since been described as *V. affine* were mistaken for *V. dentatum*, but *V. affine* occurs only in the elevated wooded portion of Eastern Missouri.

66. VIBURNUM LANTANOIDES Michx. HOBBLE-BUSH.

Recorded for Madison County by Tracy on authority of Broadhead, but I cannot imagine what shrub Broadhead mistook for this species, as nothing like *V. lantanoides* has been found in Missouri.

Recorded for Saint Louis County by Tracy on his own authority, but no shrub resembling *V. lantanoides* has been seen in the State by the writer, and I think Tracy must have had a cultivated specimen in hand when he wrote this. Tracy also records *Carya porcina* for Missouri on his own authority, but it is very doubtful if Tracy ever saw the real *C. porcina* in the State.

67. VIBURNUM LENTAGO L. SHEEP-BERRY.

Cited for Missouri by Britton in Manual, the citation being based on what Ashe has described as *V. Bushii*, without doubt.

Recorded for Jackson and Greene Counties by Tracy on

authority of Bush, but these were mistakes, and were what is now called *V. Bushii.*

Recorded for Miller County by Tracy on authority of Wirick, and doubtless a mistake.

Recorded for Saint Louis County by Tracy on authority of Letterman, and probably erroneous.

The real *V. Lentago* of the eastern States is a shrub of low wet swampy or boggy places, and ranges from Quebec to Northern Indiana, Northern Illinois, Iowa, Minnesota, North Dakota, Saskatchewan and westward. The shrub generally recognized as *Lentago* in Missouri, never grows in wet places, swampy places or bogs, but is found on rocky bluffs and banks, rocky beds of little dry branches on the prairies, and in rocky barrens on the prairies.

68. VIBURNUM OPULUS L. CRANBERRY-TREE.

Recorded for Saint Louis County by Tracy on authority of Murtfeldt, but undoubtedly this must have been from a cultivated shrub, as nothing like *V. Opulus* has ever been found in Missouri.

69. LONICERA GRATA Ait. AMERICAN WOODBINE

Recorded for Davies County by Tracy on authority of Broadhead, and evidently based on an erroneous determination by Broadhead. No specimens of this species have ever been seen by the writer from the State.

70. LONICERA HIRSUTA Eaton. HAIRY HONEYSUCKLE.

Recorded for Ralls County by Tracy on authority of Broadhead, evidently based on a misidentification of some other species of *Lonicera.* Since *L. jajonica* was not included in Tracy's Flora, and it had not yet become so firmly established throughout the State, it is likely that Broadhead saw this species in Ralls County where it had escaped, and mistook it for *L. hirsuta,* which would be quite reasonable for Broadhead to do, he not being well versed in the native flora of the State.

71. IVA FRUTESCENS L.

Recorded from Boone County by Tracy on authority of Galloway, but this coastal species has not been found in the

interior, and Galloway must have made an error somewhere about this.

72. GAYLUSSACIA DUMOSA T. & G. DWARF HUCKLEBERRY.

Recorded for Newton County by Tracy on authority of Broadhead, but a careful exploration of Jasper, Newton and McDonald Counties by Mr. Palmer and myself has failed to reveal this species there, and it is evident that Broadhead made an erroneous determination of his specimens.

73. GAYLUSSACIA RESINOSA T. & G. BLACK HUCKLEBERRY.

Recorded for Miller County by Tracy on authority of Wirick, but Wirick was merely an amateur in botany and evidently made an error in determination of his specimens, as this species is still unknown to the writer for Missouri.

74. VACCINIUM CORYMBOSUM L. SWAMP HUCKLEBERRY.

Recorded for Greene County by Tracy on authority of Shepard, but Shepard evidently mistook some other species of *Vaccinium* for this species.

Recorded for Iron County by Tracy on authority of Broadhead, but Broadhead did not know the *Vaccinium* species, and he evidently made an erroneous determination of his specimens, and no specimens of *corymbosum* are known to prove its occurrence in the State.

75. VACCINIUM PENNSYLVANIUM Lam. DWARF BLUEBERRY.

Recorded as common southeast by Tracy on his own authority, but no specimens have ever been seen by the writer from anywhere in the State, and no species of *Vaccinium* is common in southeastern Missouri.

76. VACCINIUM TENELLUM Ait. SMALL BLACK BLUEBERRY.

Cited for Missouri by Robinson and Fernald in Manual, but no specimens are known to support this citation, and a study of a great many specimens of this species showed that it does not reach Missouri, and that this citation is erroneous.

77. ARCTOSTAPHYLOS UVA-URSI (L.) Spreng. BEARBERRY.

Recorded for Missouri by Tracy on authority of Broadhead, who reports it from southeast Missouri, but no speci-

mens are known from the State, and it is very improbable that Broadhead ever found this species in Missouri.

Cited for Missouri by Robinson and Fernald in Manual.

Cited for Missouri by Britton & Brown in Illustrated Flora.

I have been unable to discover what the two citations, just above, were founded upon, but they must have been copied from some earlier citation, and this citation was based on an erroneous determination, or possibly on some collection that I have never been able to locate.

78. LEUCOTHOE RACEMOSA Gray.

Recorded for Madison County by Tracy on authority of Broadhead, but evidently an error on the part of Broadhead, as no specimens of this species are known from Missouri.

79. RHODODENDRON NUDIFLORUM Torr. PURPLE AZALEA.

Recorded for Madison County by Tracy on authority of Breadhead, but no specimens of this species are now known from the State, and if Broadhead collected some species of *Rhododendron* in Madison County it must have been another than *R. nudiflorum*.

80. BUMELIA TENAX Willd.

Recorded for Miller County by Tracy on authority of Wirick, and I am unable to guess what Wirick had in hand when he made his determination, as no species of *Bumelia* gets up into Miller County so far as I know, and this southern species does not get up so far as Missouri.

81. CHIONANTHUS VIRGINICA L. WHITE FRINGE.

Recorded for Mississippi County by Tracy on authority of Galloway, but no specimens of this species have been seen by Mr. Palmer or myself, although we have collected all around Mississippi County. It occurs in several Counties in northeastern Arkansas very close to the Missouri line, and it is probable that it occurs in one or more Counties in the extreme southern part of the state.

Cited for Missouri by Robinson and Fernald in Manual.

Cited for Missouri by Britton & Brown in Illustrated Flora.

There are no specimens to substantiate the two citations above, and many of the earlier authors and writers cited this species for Missouri, and that is the most interesting species we have on account of it being so long accepted as a Missouri species, when in fact there seems to be no evidence that ever it was collected in the State.

82. CALLICARPA AMERICANA L. FRENCH MULBERRY.

Recorded for Miller County by Tracy on authority of Wirick, but Wirick must have had specimens of some other shrub in hand when he made this determination, perhaps *Symphoricarpos orbiculatus*.

Cited for Missouri by Robinson and Fernald in Manual.

Cited for Missouri by Britton & Brown in Illustrated Flora.

It is evident that Robinson and Fernald and Britton & Brown copied from some earlier citation of this species for Missouri, and it is barely possible that some early collector really did collect this in some as yet, by me, unexplored part of Southeastern Missouri.

83. LINDERA MELISSAEFOLIUM Blume.

Recorded for Greene County by Tracy on authority of Shepard, but collections in and around Greene County by both Mr. Palmer and myself during the past fifteen years, have failed to reveal this species, and it is safe to assume that Shepard must have erred in naming his specimens.

Cited for Missouri by Britton in Manual.

Cited for Missouri by Robinson and Fernald in Manual.

There is a form that is common in Southern Missouri, that has pubescent twigs and leaves, and is certainly some different from *L. Benzoin*, and it may be the real *L. melissaefolium* of Blume, but it is not the species so regarded in the Manuals now.

84. SHEPHERDIA ARGENTEA Nutt. BUFFALO BERRY.

Recorded for Missouri by Tracy on authority of Wood in Botanist and Florist, and no doubt an error of range on the part of Wood, as this species is far to the northwest of this State.

85. FRAXINUS CAROLINIANA Walt. WATER ASH.

Cited for Missouri by Robinson and Fernald in Manual.

Cited for Missouri by Britton & Brown in Illustrated Flora.

It is impossible to tell now just how this erroneous citation first started, but it seems to have been copied one from another, and no specimens are known from the northern States.

86. SEBASTIANA LIGUSTRINA Mull.

Recorded for Saint Louis by Tracy on authority of Geyer, but Geyer's specimens if determined correctly, must have been collected in the South, as this species is not known to the northern flora. Geyer also reported *Carex Willdenovii, Gratiola aurea* and *Viola cucullata cordata,* for Missouri, of which no specimens are known to the writer from Missouri.

87. QUERCUS CATESBAEI Michx.

Recorded for Missouri by Tracy on authority of Engelmann, but certainly this is an error, as this southern oak does not get up into the northern flora. Engelmann also reported *Helianthus giganteus* for Missouri, which is clearly a mistake.

88. QUERCUS CINEREA Michx. UPLAND WILLOW OAK.

Recorded for Missouri by Tracy on authority of Swallow in Geological Report, but certainly based on specimens of some other oak, as this species does not get up into the northern flora.

89. QUERCUS COCCINEA Wang. SCARLET OAK.

Recorded for Missouri by Tracy on his own authority, who says it is common in Missouri, but Tracy did not know the species of *Quercus,* and there is little doubt that Tracy had some other species in mind when he wrote this.

This species has been commonly credited to Missouri for the last 80 years, by many collectors, writers and authors.

Cited for Missouri by Britton in Manual.

Cited for Missouri by Britton & Brown in Illustrated Flora.

Cited for Jerome, Missouri, by Sargent in Manual, based on collections of Kellogg, but very doubtful if this species.

Mr. Palmer has recently collected some interesting specimens of *Quercus* near Poplar Bluff, which he refers to this species. One of these has the leaves as in typical *coccinea*, and he places this under the typical form of that species. The other collection has leaves a little different from the typical form of *coccinea*, and the fruit is much larger, quite different in shape and texture, and the cup is quite shallow, much more so than in any *coccinea* of the East. Mr. Palmer has placed this other specimen under *Q. coccinea tuberculata* Sargent, but it appears to me that both of these collections represent but one species, and that species not *coccinea*. It is well known that *Q. Schneckii* varies in its fruiting characters just like this unknown species of Poplar Bluff, and that the form with shallow cups, large fruit, and slightly differently shaped leaves have been taken by Sargent to represent *Q. Shumardii* Buckley, a species of the lowlands of southeastern Missouri, Arkansas and Texas. *Q. rubra* (*Q. maxima*) also varies in its fruiting characters, leaf characters, and even bud characters, as does also *Q. velutina*.

90. CASTANEA VULGARIS AMERICANA Walt. CHESTNUT.

Recorded for New Madrid County by Tracy on authority of Swallow, but if this was a chestnut, it must have been a cultivated tree, as this species is not known West of the Mississippi River, or it is barely possible that Swallow must have had a tree of *Querens Muhlenbergii* in mind, as this is often called Chestnut Oak.

91. BETULA ALBA POPULIFOLIA Sp. WHITE BIRCH.

Recorded as common along streams by Tracy on his own authority, but Tracy must have mistaken some form of *B. nigra*, our only species, for this species.

92. ALNUS INCANA Willd. SPECKLED ALDER.

Recorded for Mississippi County by Tracy on authority of Galloway, but Galloway must have had specimens of *A. rugosa* in hand when he made his determination, as that is

the only species of *Alnus* of this section known to the writer in the State.

93. SALIX CANDIDA Willd. HOARY WILLOW.

Recorded by Tracy for Iron County on authority of Broadhead, but Broadhead knew almost nothing about the species of *Salix*, and he evidently made an erroneous determination of his specimens.

94. SALIX LUCIDA Muhl. SHINING WILLOW.

Recorded for Jackson County by Tracy on authority of Bush, but at that time the writer knew scarcely anything about Salix species, and made an erroneous determination.

95. SALIX PETIOLARIS Smith. PETIOLED WILLOW.

Recorded for Jackson by Tracy on authority of Bush, and certainly a mistake, as the writer was then very inexperienced in naming *Salix* species, and erroneously determined some *Salix* specimens for this species.

96. JUNIPERUS COMMUNIS L. JUNIPER.

Recorded for Greene County by Tracy on authority of Shepard, but Shepard must have mistaken specimens of trees of *J. virginiana* for this species.

97. SMILAX GLAUCA Walt. GREENBRIER.

Recorded for Missouri by Tracy on authority of Swallow, but Swallow did know the *Smilax* species, and evidently made an erroneous determination of his specimens.

BOOK REVIEWS

In this section are reviews of new, or particularly important and interesting books in the fields of natural science. Books dealing with botany or kindred subjects should be sent to the Editor, the University of Notre Dame. *All other books for review* should be sent to Carroll Lane Fenton, at the Walker Museum, the University of Chicago, Ill. Publishers are requested to furnish prices with books.

HUNTING WITH THE CAMERA. By William Nesbit. E. P. Dutton & Co., New York. Price $10.00.

This interesting and comprehensive volume of 337 pages contains information on every detail of photography. It is technical enough to satisfy the professional photographer and, at the same time, simple enough to be of genuine service to the beginner. After an interesting preface and a practical three-page exhortation to the beginner, the author discusses such subjects as the following: Wild Life Conservation, Branches of Photography, Glimpses of the Vanishing Animal Kingdom of Africa, Cameras, Lenses, Exposure, Development, Flashlight, Apparatus, and Transparency Devices. In Chapter V., we have some valuable historical and biographical data presented under the title "A Partial Who's Who in Nature Photography."

The price of the book seems rather prohibitive. But the make-up of the volume in general,—paper, print, binding— leaves little to be desired. There are twenty-four figures illustrating technical points of the camera and accessories, and about one hundred and fifty fine illustrations. All in all, it is the best and most comprehensive book of its kind that has come to our notice.—F.J.W.

COLLEGE ZOOLOGY. By Robert W. Hegner. The Macmillan Co., New York. Price $3.50.

There is still a great deal of difference of opinion regarding the most effective method of teaching the natural sciences. Many believe that zoology and botany should be presented, especially to beginners, in a combination course, called biology. Others think that we should teach zoology and botany in separate classes. Indeed, some of our larger colleges have separate buildings to house these two departments. Among those who prefer separate courses in zoology and botany there is wide difference of opinion as to the proper method of presentation to be followed in each subject. Some teachers begin with the Protozoa and lead the student slowly and somewhat laboriously through the entire

animal kingdom. Others begin with a more highly organized animal, such as the frog, and cover the entire field in more or less rambling fashion. Hegner begins at the beginning and leads the student by slow stages through the entire animal kingdom. The revised edition of his College Zoology follows the general outline of the first edition. The classification has been elaborated somewhat. This feature of the new edition does not appeal to us. The older classification as given in the old text was comprehensive enough and was more suitable for the beginner. However, this is the only adverse criticism that we have to offer on the new book. The foot notes at the beginning of each chapter are especially valuable. About seventy new illustrations have been added, and in all the illustrations, names have been substituted for guide letters. There is a good table of contents and a complete index. Altogether the new Hegner is a text book that presents the subject of systematic zoology better than any other text known to us.—F.J.W.

The American Midland Naturalist

PUBLISHED BI-MONTHLY BY THE UNIVERSITY OF NOTRE DAME,
NOTRE DAME, INDIANA

VOL. X. JANUARY, 1927. NO. 7.

THE HITCHCOCK LECTURE UPON ICHNOLOGY, AND THE DARTMOUTH COLLEGE ICHNOLOGICAL COLLECTION.†

Edited by N. M. Grier.*
Des Moines University, Des Moines, Iowa.

FOREWORD.

Charles Henry Hitchcock was Professor of Geology and Mineralogy in Dartmouth College from 1868 to 1908, and Professor Emeritus from that time until his death in Honolulu, November 5, 1919. During that period he was also State Geologist of New Hampshire from 1868 to 1878; lecturer in Geology at Mount Holyoke College for part of each year from 1870 to 1896, and taught Geology and Zoology at Williams College and in the Virginia College of Agriculture and the Mechanic Arts in 1880 and 1881. He received the honorary degree of Ph. D. from Lafayette College in 1870, and that of LL.D. from Amherst College in 1896.

The son of a distinguished geologist and college president, and of a mother notable for scholarly attainments, he enjoyed exceptional educational advantages at home, and at school received the best preparatory education provided at that time. He studied for the ministry three years at Yale and at the Andover Theological Seminary, and just before coming to Dartmouth spent a year of professional study in the Royal School of Mines, London.

Professor Hitchcock was one of the pioneer geologists of America. His field work was largely in New Hampshire, Vermont, and Maine, but it extended at times into the western and southern states, into Canada and to the Hawaiian Islands. He was chiefly interested in the glacial geology of the Champlain valley, and in the White Mountains, in fossil footprints and in volcanoes. He wrote voluminously on these subjects, and in a less exhaustive way, on many others. He was an indefatigable collector, his collections forming an enduring monument to

* Contribution from the Department of Geology and Geography, Dartmouth College.

† Paper on the program of the Paleontological Society of America at the University of Wisconsin, December 1926.

his memory in the college museum, of which he was curator during his active term of service. He was one of the founders of the Geological Society of America, of the Appalachian Mountain Club, and of the International Congress of Geologists, and in 1870-71 established the first meteorological station on the summit of Mount Washington.

For 30 years Professor Hitchcock was one of the outstanding personalities of the old and new Dartmouth. His scholarship was a notable asset to the college; his steadfast Christian character and ever ready services, an asset to the community. His enthusiasm and knowledge of his subject commanded the affectionate allegiance of those who already felt the call to devotion similar to his own; his kindly nature and gentle discipline drew to his classrooms, in lighter vein, many generations of Dartmouth men who caught there something of his spirit of sincerity and love of truth, and who gained an interest in Geology that could not have been otherwise vouchsafed to them.* Before his death, Professor Hitchcock deposited with the Department of Geology and Geography, the lecture on Ichnology. It is now reproduced on account of the quaint sidelights it throws on the man, and the branch of paleontological science so closely associated with his name.

I.—THE LECTURE.

In the year 1800 a student of Williams College was ploughing his father's field at South Hadley, Massachusetts, when he turned up a stone bearing upon its surface the imprint of birds' feet. It was not a strange sight for him to see the foot-marks of animals in the mud upon the shores of rivers or upon the highway, but he had never before seen the imprint of an animal's foot upon the solid rock. He had been taught that ledges had been suddenly called into being by the Almighty without passing through a tedious formative process. Here, however, was a phenomenon not to be explained in concordance with popular opinion. It was before the days of Geology, but Pliny Moody exercised a common sense method of explaining what he saw, for he concluded that these markings were made in an early period of the earth's history. Nothing was more natural than to surmise that they were made in the first aqueous deposit of which he had knowledge—the muddy sediment left by the Noahan

* From the Dartmouth Alumni Magazine, Vol. 12, p. 696. A memorial to Professor Hitchcock is also printed in the Bulletin of the Geological Society of America 31: 64-70.

Deluge. Hence he pointed out these markings to his friends —the specimen having been utilized as a stepping stone at his front door—as having been made by Noah's raven when wandering in search of dry land. The slab is still preserved and the impressions appear to have been made by one of that remarkable group of animals that abounded in New England during the Triassic period.

In March 1835, W. W. Draper in returning home from church passed the house of Wm. Wilson in Greenfield, Massachusetts. Some slabs about to be placed on the sidewalk leaned against the fence. A light snow upon them happened to slide off suddenly as he passed and he saw these same impressions—and remarked to his wife—"there are some turkey tracks made 3,000 years ago." This was a strictly philosophic deduction from the facts—corresponding perfectly to the deductions of Moody. Mr. Draper showed them to Mr. Wilson. Mr. Wilson exhibited them to Dexter Marsh, a stonecutter who afterwards gathered a very celebrated collection of these objects. Marsh spoke to Dr. James Deane the village physician, and Dean wrote to my father asking him as the State Geologist of Massachusetts to come and examine them and he did so.

The numerous researches demanded for the understanding of these fossil footmarks has given rise to a science which has received from Dr. Buckland the name *Ichnology*, or the science of tracks. And we may call each individual track an *ichnite*, to borrow the terminology of the science. Animals known to exist because of their tracks may be termed ICHNOZOA.* Ichnology has history. The first genuine tracks on stone ever described were those of tortoises and small reptiles in the New Red Sandstone of Scotland on the estate of Sir Wm. Jardine. They were described by Rev. Dr. Duncan in the Transactions of the Royal Society of Edinburgh, in 1828. Since then Sir Wm. Jardine has more fully described them in a splendid folio entitled the "Ichnology of Annandale." Dr. Buckland early distinguished himself by

* It is of course impossible to determine with certainty the systematic positions of all the animals which made the tracks.

attention to these tracks, and having performed some experiments upon living tortoises, some of the conductors of the literary journals who supposed the whole matter to be visionary thought the occasion a good one for witticism. A sprightly sally, (*jeu d'esprit*), of this kind that appeared in Newton's Journal for April 1828 contains too many good points to be lost, and I will read it.

FOSSIL REMAINS

"It will be remembered that the Rev. Mr. Buckland distinguished himself a few years ago by discovering a cave at Kirkdale which he proved to be the dining room of antediluvian hyenas, that had in this retreat feasted upon elephants and water-rats, and left nothing but the teeth of these titbits as records to their good living and bones of contention for future naturalists and cosmogonists. The same ingenious gentleman has lately had the good fortune to find a piece of red sandstone bearing on it the traces of an antediluvian tortoise's footsteps. The whole Geological world has been in raptures at this discovery, and in order to make sure of the fact that the steps traced in the stone were the steps of a tortoise, a meeting of the Society was held, and some soft chalk was prepared on which a modern tortoise might make his mark, and thus authenticate as it were the signature of his predecessor.

"Everything being ready for the demonstration, and the interest of the scientific company wound up to the highest pitch, the tortoise was placed on the chalk, and first of all he flatly refused to stir a step. The members upon this very properly waxed impatient, got in a rage, and began kicking and banging him about in an extremely moving manner. They had much better however have refrained from these stimulants for when the tortoise was at last prevailed upon to walk, he insisted on walking as straight as an arrow, whereas the antediluvian tortoise's march was as crooked as a ram's horn. The Society were aghast at the discrepancy. Various arguments, however, were used to console them. It was suggested that the tortoise might have forgotten the true

manner of walking while confined in the ark, and that owing to this circumstance the proper step might have been lost by its descendant; or it might be that chastened by the deluge, his slow race had returned to the path of rectitude, which they had in the universal degeneracy willfully deserted for devious ways. Or perhaps they had one way of walking on red sandstone, and another on soft chalk; one manner in private, and another before scientific beholders."

In 1834 some tracks were found in Germany, and were called by Prof. Kaup the *Cheirotherium*—the hand animal—because the foot resembled a human hand. The same tracks and also the bones of the skull having been found in England, the animal was restored, and was called the *Labyrinthodon*. It was a Batrachian and a drawing of a large frog will convey some idea of the appearance of the original. Up to this time, 1835, very little attention had been paid to the subject of footmarks. If questioned as to the existence of the impression of the feet of animals upon stone, almost any geologist of that day would have remarked, *"it is claimed by some that such a thing is possible, but it is really uncertain whether the facts are properly represented."*

In 1835, and before the account of the German footmarks had reached this country, my late honored father, at one time President of Amherst College in Massachusetts, saw certain impressions upon flagging stones in Greenfield, which wonderfully resembled the tracks of birds. To see the impressions of birds upon the solid rock, and especially to find traces of the existence of warm-blooded animals so low down in the formations among obscure clams and frigid fishes, was something far in advance of all the information acquired up to that time. Yet here were the three-toed impressions, and the succession of steps, the right and left feet, and the conviction was irresistible that they were genuine evidences of the existence of birds down in the New Red Sandstone. But to feel this truth, and to convince the world of it, were very different things; for one must see in order to believe, and slabs of stone cannot be carried to everyone's fireside

like a pamphlet. Accordingly the summer of 1835 was spent in the examination of all the quarries in the Connecticut valley, to see if the slabs of Greenfield alone exhibited the impressions; museums and menageries were visited to examine the forms of the feet of birds and other animals; and libraries were scanned in search of facts from foreign sources. As the result of this investigation there appeared in the January number of the American Journal of Science and Arts (1836) an account of seven species of footmarks, called *Ornithichnites,* or stony bird tracks.[2] This was the first publication in this country upon this subject, followed five years later in the Final Report on the Geology of Massachusetts of 32 different kinds,[3] some of them quadrupeds as well as birds. But these new ideas met with violent opposition and even ridicule from the public, and especially from the Geologists. A committee of five of the most learned members of the American Association of Geologists and Naturalists were deputed to visit this discoverer, his quarries and specimens, and though those most opposed to the new doctrine were members of the committee, their report stated "that the evidence entirely favors the views of Prof. Hitchcock and they regret that a difference had existed, if they did not feel assured it would lead to greater stability of opinion." The public acquiesced in the report, and since that time, after seven years of opposition, the world has accepted the fact of a new principle discovered, have applauded the author, and have aided his researches by liberal contributions.*

Animated by the enthusiasm of discovery, the original expounder of the bird-tracks for a subsequent period of twenty years, as long as life continued, collected specimens, described them in the publications of learned societies, and amassed a multitude of facts about the progression of living animals.

---

(2) 1836. Hitchcock E. Ornithichnology. Description of the Footmarks of Birds. (Ornithichnites) on New Red Sandstone in Massachusetts. Amer. Journal Science XXIX. pp. 307-40, pl. I, Fig. 1-201 23-24; pl. II. No. 2, 21-22, pl. III.

(3) 1841. Hitchcock E. Final Report on the Geology of Massachusetts, Pt. III, pp. 301-714, pls. XV-LI. Amherst and Northampton.

Three important publications appeared from his pen describing the footmarks: first in 1848,[4] when 52 varieties were figured and described; next in 1858,[5] when the Legislature of Massachusetts came nobly forward and issued a quarto volume, containing a complete exposition of the whole subject, a volume of 232 pages and 60 plates, and descriptive of 119 species; and lastly a supplement to the same, issued by the same government in 1865, bringing up the number of species to 150.

From the very first the attempt was made to accumulate slabs of footmarks in a museum. Up to 1853 the effort was single and unaided. At that time the occasion of the sale of a large collection of slabs led to contributions from friends, continued from time to time for ten years. Only the results need be stated: contributions to the extent of $11,500, a building 100x40 feet containing 20,000 impressions of the feet of animals upon a great variety of slabs placed at every angle in order to secure the advantage of the best light. This museum, named after its founder since his decease, is the only building in the world entirely devoted to the subject of Ichnology.* Its fame extends to all countries, and the institution to which it now belongs, is known abroad largely on account of this collection committed to their care. Those who would become acquainted with the science of Ichnology

(4) 1848. Hitchcock E. An attempt to disemminate and describe the animals that made the fossil footmarks of the United States and especially of New England. Mem. Amer. Acad. Arts and Sciences. (2) III., pp. 129-256, pls. 1-24.

(5) 1858. Hitchcock E. Ichnology of New England. A report on the sandstone of the Connecticut Valley, especially its fossil foot marks. Boston.

1865. Hitchcock E. Supplement to the Ichnology of New England, Boston.

* For a list of Professor C. H. Hitchcock's publications compiled by himself up to the year 1907, see the Bulletin of the Geological Society of America 31:70-80, 1920.

* The Appleton Ichnological Cabinet at Amherst College, Amherst, Massachusetts.

† Professor Hitchcock's constant references to these caused him to be nicknamed "Type" by his students.

must visit it, as it contains the types† of all the descriptions, and specimens of every variety known in the Connecticut Valley. It is one of the best instances in this country of a museum devoted to one definite and limited branch of knowledge, but containing in profusion all objects needed to illustrate the minutest details. It is by the multiplication of these illustrations of single ideas, that science will progress and the world be benefitted.

It will be proper now to state the manner in which these *ichnites* occur. They occur in the middle of the Connecticut River Sandstone over a distance of 80 miles from Gill, Massachusetts, to Portland, Connecticut, generally upon fine micaceous shales. Upon cleaving the strata, the *ichnites* are seen depressed upon the lower layer, while the upper layer has upon its under surface the casts of the depressions. Among the many thousand specimens exhumed not one has been an exception to this rule. If we can place ourselves in imagination upon this ancient shore we can see the process of forming the tracks. We stand upon the shore of an estuary running inland from Long Island Sound. The tide just fallen has deposited a layer of soft mud. The birds and reptiles emerge from their hiding places and frequent the shore for food. They tread upon the mud and return. The heat of the tropical sun hardens this trodden surface, and the tide deposits another layer. The second layer in turn receives the impression of feet, is hardened and covered. Or the birds may have assembled at the mouth of a small river. A flood has distributed mud upon its banks. Trodden upon and hardened by the same agencies these also are changed into stone and preserved for the Geologist. Sometimes the layers formed so rapidly that to the depth of several inches they retain their softness. Then the impression extends through several layers, and when cleaved the lowest impression may be partial, e. g., in a bird's foot only the middle toe made a mark. Thus an inexperienced observer might ascribe the impression upon the lowest layer to an animal very different from the one who trod the upper surface.

These impressions could not have been made beneath the water because in connection with them are found the prints of rain drops. The drops have each left a round impression which completely cover the surface. They are preserved most perfectly when it barely sprinkles. In a heavy or long continued shower, so many impressions are made that they coalesce and leave no distinct trace of their existence, and resemble a chopped sea. Thus there are found specimens denoting every variety of shower—from sprinkling of fine drops to the thunder storm. There are the large drops of a passing cloud, and the wind that drove the cloud caused the drops to impinge at an acute angle and thus elongate the impression in the direction of the wind. Here then we have the weathercock and raingauge of geologic days, which record with certainty the direction and force of the wind and the amount of rain that fell. Different layers indicate a difference in the direction of the wind. Surely then in these primitive times there were changes in the weather from wet to dry just as now. Sometimes the impressions of the minutest striae and papillae of the foot are preserved—such delicate impressions that a lens is needed to distinguish the marks. The tracks of small insects are numerous—hundreds upon a square foot of surface. To retain such delicate impressions as the feet of flies and beetles the mud must have been very soft and very quickly hardened by a tropical sun so that the overflowing waters would not obliterate the impressions. Indeed the character of the animals and of the vegetation is entirely tropical.

This manner of formation of the tracks and of the strata shows why scarcely any remains of the animals beside their tracks are found. The shore seems to have been the common feeding ground. Consequently if any of them died there, their remains would probably have been devoured or floated away by the water. Such a spot therefore is the least likely of any to contain organic remains.

In describing these animals of the sandstone from their tracks it is important to know what characters can be derived from their feet. Let us take known animals. Man's foot is different from the foot of every other animal—the short toes

distinguish it from the foot of the ape, the nearest approach of the animal kingdom to man. How different birds' feet are from quadrupeds—tortoises, frogs, lizards, and caterpillars. In fact there is not a single class of animals that does not have some peculiarity in its feet which may be generally noticed. By comparing the size of modern animals with their tracks we have multipliers for each class, and can therefore estimate the size of these early birds.

Cuvier has finely described the definiteness and certainty with which we can infer the character of an animal from its track, although when he wrote fossil footmarks were unknown. "Anyone," says he, "who observes merely the print of a cloven hoof may conclude that it has been left by a ruminant animal, and regard the conclusion as equally certain with any other in physics or morals. Consequently, this single footmark clearly indicates to the observer the forms of the teeth, of all the leg bones, and of the trunk of the body of the animal which left the mark. It is much surer than all the marks of Zadig."

There are certain characters that are constant and distinctive in the feet of animals and in their mode of progression which are used in learning the nature of the animals. Thirty of them are given of which I will mention a few. These are the number of feet, mode of progression, length of step, webbed feet, number of toes, angles of the toes with each other, position of the hind toe, the claw, number and length of the phalangeal impressions, the form and position of the heel, under side of the foot—even or irregular, character of the integuments—pitted, ridged, or convoluted, character of the caudal appendages. Guided by these principles I made the following classification of the species of Ichnozoa in 1888—

1 Marsupial.
17 Biped Animals with pachydactylous feet.
18 Biped Animals with leptodactylous feet.
27 Dinosaurs.
28 Reptiles.
16 Amphibians.

6	Chelonians.
4	Fishes.
24	Insects.
16	Crustacea and inferior Arthropods.
5	Molluscs.
6	Uncertain.
178	Species

ARCHAEOPTERYX

First evidence of the existence of a bird in the Jurassic series was afforded by the impression of a single feather on the lithographic stone of the famous quarry at Solenhofen in Bavaria. It was described with great minuteness by Herman Von Meyer in 1861. He applied to it the name of *Archaeupteryx lithographica* or *ancient bird of the lithographic stone.* A few months later Professor Andreas Wagner communicated to the Royal Academy of Science of Munich the discovery in the same quarry of the greater part of the skeleton of an animal with feathers. Without having seen the specimen, Professor Wagner conceived that the animal was a peculiar flying reptile, long known in that formation by the presence of its bones, and called it *Gryphosaurus.* The specimen afterwards came into the possession of the British Museum in London, and was very completely examined and described by Professor Owen, who perceived that its feathers were like the single one described by Von Meyer, and therefore he retained the former name, besides establishing fully the ornithic relation of the animal. It approaches nearest to the birds represented by the living raven, owl and falcon. The wing extremities are not different from those of the falcon, except it has no free fingers and the wrist bones are not so much anchylosed. There are five living birds possessing one or two free claws. The pterodactyl has four. There are four toes in the *Archaeopteryx* of which the two first are consolidated as in all birds. In the pterodactyl these two coalesce and are enormously lengthened as in bats, for the support of the flying membrane. The bones of the feet are

precisely like those of "Incessores." There are three toes directed forward and one behind. Its tarso-meta-tarsal is consolidated as in all birds, and unlike those of pterodactyls.

Archaeopteryx has 20 caudal vertebrae, a young ostrich has 18-20, an embryonic rook, ten. The first five of these vertebrae show transverse processes, progressively diminishing in length and breadth. The length of the 1st caudal is 3½ lines; increasing to 6 lines in the eighth vertebrae, the same length to the sixteenth when they diminish to the last, which is five lines long. Each vertebrae has a pair of feathers attached one on each side. The principal ones diverge from the central line at an angle of 40 degrees, becoming more acute at the extremity. The tail was 11 inches long, expanding gradually to a width of 3½ inches beyond the last bone, while the end was obtusely rounded out, and shaped like a squirrel's tail. The first feathers, one inch in length, increase to five inches in the 15-17th pairs, and then diminish to 3 inches and 8 lines. The quill feathers of the wings were 6 inches in length and 1 inch in width. Their arrangement was similar to that of living birds.

THE SANDSTONE BIRD

By Edward Hitchcock

Scene—Banks of the Connecticut River.
Geologist alone examining the footmarks of a bird.
(Ornithichnites giganteus)

Foot-marks on stone! how plain and yet how strange!
A bird track truly though of giant bulk,
Yet of the monster every vestige else
Has vanished. Bird, a problem thou hast solved
Man never has: to leave his trace on earth
Too deep for time and fate to wear away.
A thousand pyramids had mouldered down
Since on this rock thy footprints were impressed;
Yet here it stands unaltered though since then,
Earth's crust has been upheaved and fractured oft.
And deluge after deluge o'er her driven,
Has swept organic life from off her face.(1)
Bird of a former world, would that thy form
Might reappear in these thy ancient haunts.
Oh for a sorceress nigh, to call thee up
From thy deep sandstone grave as erst of old
She broke the prophet's slumbers. But her arts
She does not practice in this age of light.

Enter Sorceress.

"Let the light of science shine,
I will show that power is mine
Sceptic, cease my art to mock
When the dead start out of rock.
Bird of mighty foot (Oh vain)
Ornithichnites called by name;
Science thus her ignorance shows,
On a footmark to impose
Name uncouth; while by my arts
Into life the biped starts.
Bird of sandstone era, wake!
From thy deep dark prison break.

1. This poem proceeds on the supposition now so extensively adopted by geologists that all the organic remains found in the secondary rocks belong to animals and plants that lived and died in the long interval that might have intervened between the beginning as described in Genesis and the creation of man. During this interval it would seem that several distinct races of organized beings were successively created and destroyed, each race being adapted to the state and climate better than other conditions of the globe.

Spread thy wings upon our air,
Show thy huge strong talons here:
Let them print the muddy shore
As they did in days of yore.
Pre-adamic bird, whose sway
Ruled creation in thy day,
Come obedient to my word,
Stand before Creation's Lord."
The sorceress vanished, but the earth around,
As when an earthquake swells her bosom, rocked.
And stifled groans with sounds ne'er heard before
Broke on the startled ear. The placid stream
Began to heave and dash billows on the shore;
Till soon, as when *Balaena*(2) spouts the deep,
The waters suddenly leaped towards the sky,
And up flew swiftly, what a sawyer(3) seemed,
But proved a bird's neck, with a frightful beak.
A huge shaped body followed, stilted high,
As if two main masts propped it up. The bird
Of sandstone fame was truly come again,
And shaking his enormous plumes and wings,
And rolling his broad eye around amazed,
He gave a yell so loud and savage too,
Though to *Iguanodons* and kindred tribes(4)
Music it might have seemed, on human ear
It grated harshly, like the quivering roar
That rushes wildly through the mountain gorge,
When storms beat heavy on its brow. Anon,
On wings like mainsails flapping on the air,
The feathered giant sought the shore where stood,
Confounded, he who called the sorceress' aid.
Awhile surveying all the monster paused,
The mountain, valley, plain, the woods, the fields,
The quiet stream, the village on its banks,
Each beast and bird. Next the geologist
Was scanned, and scanned again with piercing glance.
Then arching up his neck, as if in scorn,
His bitter taunting plaint he thus began.

2. The whale, the largest of known animals, sometimes weighing 50 tons.

3. *A sawyer* is a tree which being undermined by a current of water falling into the stream lies with its branches above water which are continually raised and depressed by the force of the current. (Webster.)

4. The *Iguanodon* is an enormous herbivorous reptile, between 60 and 70 feet long, discovered in England in the rocks but no longer alive. It was more than twice as long as the longest crocodile. Another kindred animal was the *Megalosaurus*, 70 feet in length. Several others extinct might be named.

"Creation's Lord! the magic of these words
My iron slumbers broke, for in my day
I stood acknowledged as creation's head,[5]
In stature and in mind surpassing all.
But now, O, strange degeneracy! one,
Scarce six feet high, is styled creation's lord!
If such the Lord, what must the servants be!
Oh how unlike Iguanodon next me
In dignity, yet moving at my nod.
Then *Mega-Plesi-Hylae-*[6] Saurian tribes—
Ranked next along the grand descending scale:
Testudo[7] next below the *Nautilus*
The curious *Ammonite* and kindred forms,[8]
All giants to the puny races here,
Scarce seen except by Ichthyosaurian eye,[9]
Gone too the noble palms, the lofty ferns,
The *Calamite, Stigmaria, Voltzia* all:[10]
And Oh! what dwarfs, unworthy of a name,
Iguanodon could scarce find here a meal!
Grow on their graves! Here, too, where ocean rolled,
Where coral groves the bright green waters graced,[11]
Which glorious monsters made their frolic haunts,

5. Before the discovery of these *Ornithichnites* the most perfect animals that had been found as low in the rocks as the New Red Sandstone, were a few reptiles called *Saurians*, so that birds must have been decidedly the most perfect animals that then existed, though it has been recently announced in the journals that the tracks of quadrumanous animals have been found in the New Red Sandstone in Germany. But until I have seen the details of this discovery I am not disposed to let it spoil my poetry, for as to some quadrumanous animals I think that birds might successively compete with them the palm of superiority.

6. These are huge reptiles found fossil in England. They do not indeed occur as deep in the rocks as the New Red Sandstone, but since all belong to extinct races, the anachronism may be pardoned in poetry.

7. The tracks of the tortoise (*Testudo*) have been found in the New Red Sandstone.

8. The *Nautilus* and the *Ammonite* are curious chambered shells, found petrified chiefly.

9. The *Ichthyosaurus*, another extinct and huge saurian animal remarkable for the size of the eye, the orbit in some specimens measuring ten inches in length and seven inches in breadth.

10. The organic remains found in the rocks of the temperate and frigid zones correspond more nearly to those now found alive in the torrid zone than to those in the temperate and frigid zones. Indeed there can be no doubt but the northern hemisphere was once covered with tropical forests, such as the palms and ferns of huge size. The *Calamite*, *Stigmaria* (*Sigillaria*) and *Voltzia*, are names given to plants found in the New Red Sandstone which do not correspond to any now growing on the globe.

11. A sea fan (*Gorgonia Jacksonis*) not less than 20 feet high, is said to have been found in the rocks at West Springfield. No living *Gorgonia* even in tropical seas, is more than twelve feet high and this tribe of organized beings forms a large part of what are called "coral groves." Hence there is sufficient ground for representing the valley of the Connecticut as once covered by a tropical ocean, containing groves of coral. The enormous bird, that is described in the text, probably at least twice the size of the ostrich, is supposed to have frequented the shores of this ocean in search of food; and to have left its footmarks upon the mud, which was afterwards hardened into stone.

Where strange *Fucoides*, strewed its very bed,[12]
And fish of splendid forms and hues, ranged free,
A shallow brook troop, where only creatures live
Which in my day were Sauroscopic called,[13]
Scarce visible, now creeps along the waste.
And Oh! this chilling wind! a contrast sad
To those soft balmy airs, from fragrant groves,
That fanned the never varying summer once.
E'en he, whom I've heard called creation's lord,
(I call him rather Nature's blasted slave,)
Must smother in these structures dwellings called,
(Creation's noble palace was my home.)
Or these inclement skies would cut him off.
The Sun himself shines but with glimmering light,
And all proclaims the world well nigh worn out,
Her vital warmth departing and her tribes,
Organic, all degenerate, puny soon,
In nature's icy grave to sink forever.[14]
Sure 'tis a place for punishment designed,
And not the beauteous happy spot I loved.
These creatures here seem discontented, sad:
They hate each other and they hate the world,
I can not, will not live in such a spot.
I freeze, I starve, I die: with joy I sink,
To my sweet slumbers with the noble dead.
Strangely, and suddenly the monster sank,
Earth ope'd and closed her jaws, and all was still.
The vex'd geologist, calling aloud
Reached forth his hand to seize his sinking form;
But empty air alone he grasped, chagrined,
That he could solve no geologic doubts,
Nor have the history of sandstone days,
He passed out bitter words, 'gainst sorcery's arts,
Forgetting that the lesson thus taught pride,
Was better than new knowledge of lost worlds.

Amherst, March 1, 1836.

12. *Fucoides* are fossil sea weeds, (?) resembling plants of the same tribe, (*Fucus*) now growing in the tropical seas.

13. Sauroscopic. That is, seen only by the eye of the *Ichthyosaurus*. "The shallow brook" is the Connecticut river. (!)

14. If it be admitted that the climate and vegetation and animals of this valley were tropical when this bird lived, who will say that its present condition would not seem, even to a rational being, in spite of circumstances to be one of deterioration, and approaching ruin?

I will now relate an Indian tradition respecting the former existence of an enormous bird on this continent. No part of the United States, not even the highlands of the Hudson, can vie in wild and romantic scenery with the bluffs of Illinois. On one side of the river, often at the water's edge, a perpendicular wall of rock rises to the height of some hundred feet. Generally on the opposite shore is a level bottom, or prairie several miles in width extending to a similar bluff that runs parallel with the river. One of these ranges commences at Alton and extends with few intervals for many miles along the left bank of the Illinois. In descending the river to Alton, the traveller will observe between that town and the mouth of the Illinois, a narrow ravine through which a small stream discharges its waters into the Mississippi. That stream is the Piasa. Its name is Indian, and signifies in the language of the Illini, *the bird that devours men.* Near the mouth of that stream on the smooth and perpendicular face of the bluff, at an elevation which no human art can reach, is cut the figure of an enormous bird with its wings extended. The bird which this figure represents was called the Piasa by the Indians, and from this is derived the name of the stream.

The tradition of the Piasa is still current among all the tribes of the upper Mississippi, and those who have inhabited the valley of the Illinois, and is briefly this: many thousand moons ago, before the arrival of the pale-faces, when the great *Megalonyx* and *Mastodon* whose bones are now dug up were still living in the land of the green prairies, there existed a bird of such dimensions that he could easily carry off in his talons a full grown deer. Having obtained a taste of human flesh, from that time on he would prey upon nothing else. He was artful as he was powerful, and would dart suddenly and unexpectedly upon an Indian, bearing him off into one of the caves, and there devour him. Hundreds of warriors attempted for years to destroy him but without success. Whole villages were nearly depopulated, and consternation spread through all the tribes of the Illini. At length Ouatoga, a chief whose fame as a warrior extended even be-

yond the Great Lakes, separating himself from his tribe fasted in solitude for a whole moon, and prayed to the Great Spirit the Master of Life that he would protect his children from the Piasa. On the last night of his fast the Great Spirit appeared to Ouatoga in a dream, and directed him to select twenty of his warriors, each armed with a bow and poisoned arrows, and conceal them in a designated spot. Near the place of their concealment, another warrior was to stand in open view as a victim of the Piasa which they must shoot the instant that he pounced upon his prey. When the chief awoke in the morning he thanked the Great Spirit and returning to his tribe told them his dream. The warriors were quickly selected and placed in ambush. Ouatoga offered himself as the victim. He was willing to die for his tribe. Placing himself in open view of the bluff, he soon saw the Piasa perched on the cliff eyeing his prey. Ouatoga drew up his manly form, and planting his feet firmly on the earth began to chant the death song of the warrior. A moment later the Piasa rose into the air and swift as the thunder bolt darted down upon the chief. Scarcely had he reached the victim when every bow was sprung and every arrow sent to feather in his body. The Piasa uttered a wild fearful scream and expired. Ouatoga was safe. Not an arrow, nor even the talons of the bird had reached him. The Master of Life in admiration of his generous deed had held over him an invisible shield. In memory of this event the image of the Piasa was engraven on the face of the bluff. Such is the Indian tradition.

Among the deductions deriving from the study of these foot marks we may derive an important moral lesson. To leave our names inscribed on the world's history is a universal desire of mankind. To be distinguished, men have sacrificed comfort, health, life, and even moral principle, and yet have been unable to crawl into the remotest corner of history. Not a track remains nor a single hoof, of all the countless multitude of men and beasts whose warlike progress in ancient times has spread desolation over the earth. But the reptiles and worms that crawled upon the half-finished

surface of our planet, have left memorials of their passage enduring and indelible.

Take a case often observed among these footmarks. We sometimes notice a change in the direction of the animal as it moved along, and of course an impression on the rock deeper or more shallow than usual, of portions of the foot, by the action of the muscles employed in changing the animal's course. Here then we have a register of so slight an action as the turning of an animal's line of march. Nay more! The movement of the muscle implies an act of will (and that will acted by a nerve current first inward along the sensor nerves and then outward through the motor nerves.) Let human ambition then learn a lesson of humility as it sees the register of the act of an animal's will, itself finding its mightiest efforts unable to save it from early oblivion, while these senseless brutes carry off the palm of immortality.

But he who performs noble actions need not despair. These brutes had only dead matter to work upon. We have living mind to influence—indestructible immortal mind; then let us act nobly and thus

> "departing leave behind us
> footprints on the sands of time."

II.—THE DARTMOUTH COLLEGE ICHNOLOGICAL COLLECTION.

The specimens illustrating the footmarks of the Triassic period in the Connecticut Valley consist of slabs brought to Dartmouth by Professor C. H. Hitchcock in the early days; slabs purchased from T. M. Staughton by the College in 1906 and installed in the Butterfield Museum at Dartmouth in 1908, slabs resulting from fresh excavations at Turners Falls, Massachusetts, by C. H. Hitchcock in the summer of 1906. A very few slabs also were dug up on the outskirts of Granby, Massachusetts, at the same time. To these have been added still earlier collections—one from the Carboni-

ferous of Kansas brought with the Butterfield specimens and another from rocks of the same age in Nova Scotia collected by Professor Hitchcock about 1894. The slabs are now installed in cases on the second floor of the Butterfield Museum, and fastened upon the walls or displayed upon tables in room 302 of that building. The rock making up the slabs has an estimated weight of 140 lbs. to the cubic foot. Where dimensions of the slabs are given they are in the order of length, breadth, and thickness.

The combinations of various fossil remains found on certain of the slabs prevents any convenient systematic listing of them according to the type of impressions upon them, so they are now given in the order in which Professor Hitchcock numbered them, without regard to the position of the contained fossils in the animal or plant kingdom. Footnotes indicate the present accepted classification of the life represented. Professor Hitchcock used the nomenclature of his father's publication of 1848 (*loc. cit.*) in his notes, but I have revised his data following that given by Lull, (6). Wherever comments are made upon any of the slabs they are those of Professor Hitchcock exclusively, but at times they have been slightly modified to make them clearer to the reader. Where no remarks are found, it must be assumed that Professor Hitchcock did not find time to closely examine the particular specimen, but thought it worthy of preservation for further study. The Dartmouth College Ichnological Collection is available for the use of those who may be interested in this branch of paleontological science. Specimens which are not starred may be exchanged for other museum material offered by institutions, or otherwise disposed of at the discretion of the Chairman of the Department of Geology and Geography.

* No. 1. Impression of rain drops from the Lily Pond in the vicinity of the mouth of Miller's river, a tributary of the Connecticut. Size of slab 3 ft. 7 in. by 1 ft. 2 in. by 1 inch.

---

* Not available for purchase or exchange.

6. Lull, R. S. Triassic Life of the Connecticut Valley. State of Connecticut Geological and Natural History Survey, Bull. No. 24, 1915.

No. 2. Showing two tracks in succession resembling those of the old *Brontozoum expansum*† of E. Hitchcock, 1848, (*Anchisauripus expansus* after Lull). The length of the step is greater, (29 in.), than the normal (25 in.) but there is agreement in other respects. Also two odd impressions perhaps of *Grallator cuneatus*(1) E. Hitchcock and mud cracks. Size of slab 3 ft. 3 in. by 1 ft. 6 in. by 1½ in.

No. 3. *Anchisauripus sillimani* (E. Hitchcock) and *Anchisauripus hitchcockii* Lull.(2)—(Footprints of *Anchisaurus* sp.) Size of slab 3 ft. 7 in. by 2 ft. 8 in. by ¾ in.

No. 4 Exhibiting abundant plant remains and quadrupedal tracks suggesting *Batrachopus gracilis* (E. Hitchcock).(3) The tracks of *Grallator* sp. are present in relief. Lily Pond. Size of slab 4 ft. 7½ in. by 3 ft. 2½ in by 1⅛ in.

*5. The tracks of *Anchisauripus sillimani* (E. Hitchcock),(2) *Anchisauripus hitchcockii* Lull and *Grallator cuneatus* E. Hitchcock,(1) Lily Pond. Size of slab 3 ft. 6 in. by 3 ft. 5½ in. by 1 in.

*6. Exhibiting two large trifid impressions, with a distance of 34 inches between them. These apparently represent an aberrant form suggestive of *"Anchisauripus expansus"* or *Anticheiropus hamatus*(4) E. Hitchcock. Thought by Professor Hitchcock to be an undescribed animal "which had a large terminus for the body of the foot," but a poor development of the toes. There are also a multitude of small quadrupedal tracks. Lily Pond. Size of slab 6 ft. by 3 ft. 8 in. by 3¼ in.

*7. Exhibiting many tracks of *Anchisauripus hitchcockii* Lull., *Anchisauripus sillimani* (E. Hitchcock), and some small

† This name was abandoned after the publication of the Fossil Footmarks of 1848. Hay (Bull. U. S. Geological Survey 179: 543) states that "the materials on which this species was based have evidently been assigned to some other species; which one cannot be determined."

(1) A Theropod Dinosaur, family Grallatoridae.

(2) A Theropod Dinosaur, family Anchisauripodidae.

(3) A Parasuchian reptile, family Batrachopodidae.

(4) An ichnite, *incertae sedis*.

3-4 toed animal. A large track of *Eubrontes*[5] or *Anchisauripus* is in the lower corner. Lily Pond. Size of slab 5 ft. 6 in. by 5 ft. 10 in. by 1 in.

*8. Displaying one fine track of *Anomoepus giganteus*[6] C. H. Hitchcock sp. nov. from Granby crossing or Aldrich's Mills, Mass. The specimen has the distinctive *Anomoepus* heel. A lower track is very dim and is not certainly made out. There is some resemblance to *Amblonyx*[6] (*Sauropus*) or *Aethyopus* (*Sauropus*) but this is not a final conclusion. Size of slab 6 ft. 5 in. by 3 ft. 2 in. by 1 in.

9. Various undetermined footprints from the Lily Pond region. Size of slab 4 ft. by 2 ft. 6½ in. by 2½ in.

*10. Presenting tracks of *Grallator cuneatus* E. Hitchcock?[1] *Anchisauripus tuberosus* (E. Hitchcock)?[2] From Granby, Mass. Size of slab 5 ft. 10 in. by 3 ft. 6 in. by 1 in.

*11. Has a row of five tracks of *Eubrontes divaricatus* (E. Hitchcock[5] and one of *Eubrontes giganteus* E. Hitchcock.[5] Lily Pond. Size of slab 13 ft. 6 in. by 2 ft. 7 in. by 2½ in.

12. Track of *Eubrontes divaricatus*[5] (E. Hitchcock). Size of slab 9 ft. 7½ in. by 5 ft. by 3½ in.

*13. Indicating ripple marks. Collected at Horse Race on Connecticut River, near Miller's Corner, Mass. Size of slab 5 ft. by 4½ in. by 1½ in.

*14. Along middle row six tracks of *"Anchisauripus expansus"* good enough to be typical specimen for this proposed species."† On one side a row of four tracks of *Anchisauripus sillimanni* (E. Hitchcock)[2] and an odd one near another side. Opposite the first named are the best known tracks of *Anomoepus gracillimus* (E. Hitchcock)[6] with as many as 14 imprints of the pes and 5 of the manus. There was originally another of each of the feet in a triangular hole filled with cement. It was cut out by one of the Amherst College students when visiting the quarry with Professor B. K. Emerson. Size of slab 11 ft. 6½ in. by 3 ft. 1½ in. by 3 in.

*15. Exhibiting the track of an annelid from one corner

(5) A Theropod Dinosaur, family Eubrontidae.

(6) An Orthopod Dinosaur, family Anomoepodidae.

diagonally across to a lower one. This is suggestive of *Acanthichnus tardigradus* E. Hitchcock, (*Pterichnus centipes* E. Hitchcock).[7] One section includes many plant impressions, including piece of bark with leaf scars. There is also a track like the rounds of ladder without the sides. *Anchisauripus sillimani* (E. Hitchcock)[2] is represented by a "beautiful" track near the middle of slab. Size of slab 7 ft. 5½ in. by 3 ft. by 2 in.

16. Showing various *Grallator* imprints.[1] Size of slab 6 ft. 6 in. by 5 ft. by 2¼ in.

17. A row of the tracks of *Anchisauripus hitchcockii* Lull.[2] nine in number, many of the impressions very distinct. "I was disposed to make this slab a type of the description not made out by Lull in his notice of the species. He gave only the reference to the Middletown slab at Amherst, 194, without measurements. There are other individual tracks of this animal upon this slab." Size of slab 12 ft. 4 in. by 3 ft. by ⅝ in.

*18. "More tracks of *Eubrontes giganteus*[5] E. Hitchcock, and what is remarkable, these seem to be impressions of two other feet just in front. Can it have been a quadruped? There is a slab like it at Amherst but no thought there of its being quadrupedal." From the Lily Pond. Size of slab 11 ft. 5 in. by 1 ft. 8 in. by 1½ in.

19. Five tracks in relief of a *Grallator*[1]—a sixth imprint having been obscured by a triangular area 3 ft. long of elevated roundish and elongated spots suggestive of *Batrachoides nidificans* E. Hitchcock[4] "The surface is not the one actually deposited upon the floor. It walked upon a layer about ⅛ in. in thickness which has been peeled from it, but this layer has been preserved in No. 20, and in slabs sent to the Carnegie Museum in Pittsburgh, and to Amherst. I believe the *Batrachoides* part of the depressed surface was sent to Amherst and there are several small pieces of related character in the Butterfield Museum at Dartmouth. No well defined *Batrachoides* was found at Lily Pond. I proposed the

(7) The trail of an Arthropod, *incertae sedis*.

new generic name *Koilosoma* for *Batrachoides*. (The latter name is pre-occupied by Lacépéde for a genus of fishes.)

*20. Displaying the tracks of what is probably a new species of Dinosaur. The foot is 6 in. in length, and there is very little variation in the length of step of 24 in. It comes in some respects near to *Grallator cuneatus* E. Hitchcock,[1] but the length of step of the latter (22-24 in.), and its foot (4.9-5 in.) is smaller. The distance between the tips of the lateral toes is 3.25 inches in this species, and but 2.9 in *cuneatus*. The apparently new form lacks the cuneate heel. Possibly it is "*Grallator rectus*." A thumb seems to be present upon one of the slabs. I got it in 1906 at Lily Pond. Having dug down some 15 feet without very good success I came to a layer well covered with plant impressions—and a row of tracks of this animal, 17 in number in a straight line. There are several individual specimens of this in the Dartmouth Collection. Size of slab 5 ft. 3 in. by 5 ft. 1½ in. by 1½ in.

21. Exhibiting red sandstone with tracks in relief from the Dickinson Quarry in South Hadley, Mass. The counterpart to this is in the Museum of Mt. Holyoke College. "Interest is attached to these tracks on account of their resemblance to *Grallator cuneatus* E. Hitchcock[1] only the length of the step is not great enough. There are two tracks side by side as if the animal stood still for a time—as otherwise one track would have been in advance of the other. But there is a tailmark—indicating an animal more of the *Anomoepus*[6] kind which carry tails while the *Grallator*[1] has never been known to possess one. I thought at first this specimen belonged to a *Grallator* and as such proved the presence of a tail." The creature now seems to me to be allied to the *Anchisauripus hitchcockii*[2] Lull, but there is room for further study." Two or more tracks of *Grallator gracilis* C. H.[1] Hitchcock are on this slab. This locality is remarkable for the many kinds of *Anomoepus* found—all the specimens of which are preserved in the Mt. Holyoke College Museum except this one and another in the Dartmouth College Collection. It is difficult to obtain more specimens

except at great cost for excavation—since the quarry is on a hill nearly a mile north of the College. Size of slab 3 ft. 3 in. by 1 ft. 6 in. by 2 in.

22. A slab whose track at one corner is remarkable for the great bend inwards of the middle toe. Impressions of insects and minute trails of various sorts are present. Size of slab 4 ft. 1 in. by 2 ft. 1 in.

*23. Exhibiting plant remains resembling palm leaves. Comparison is suggested with the lower side of No. 18. Size of slab 3 ft. by 2 ft. 10 in. by 1¼ in.

*24. A slab showing four tracks of a small quadruped, *Batrachopus*.[3] Length of step 8 in. Nothing like it has been described. To be compared with No. 6. The trails of insects and other animals are present, as well as impressions of plants. Also a trail resembling that of *Copeza* sp.[10] Plants. "Apparently obtained from near No. 22." Size of slab 3 ft. 3 in. by 6 in. by 1¼ in.

*25. Displaying several impressions near together of a form resembling *Anomoepus*,[6] or *Plesiornis*,[8] and *Anchisauripus sillimani* (E. Hitchcock).[2] Size of slab 2 ft. by 1 ft. 9 in. by 1¼ in.

26. Footprints of *"Anchisauripus expansus"*† Size of slab 4 ft. by 1 ft. 6 in. by 1½ in.

27. Footprints of *Anomoepus*[6] Size of slab 2 ft. 6 in. by 1 ft. 10 in. by 1 in.

28. Three tracks of *Grallator gracillis*[1] C. H. Hitchcock with rather long step. Surface also shows plant impressions and insect tracks. Two tracks of *Grallator gracilis* also near one side. Size of slab 4 ft. 3½ in. by 2 ft. 6½ in. by 1¼ in.

*29. Fossilized impressions of rain drops. Size of slab 3 ft. by 1 ft. 11 in. by 1 in.

30. A slab showing a large track with a step of 2 ft. 8 in. Also a small *Grallator*, with a step of 18 in. Surface resembling the impressions of palm leaves and many small particles suggestive of scattered seed. Size of slab 4 ft. by 2 ft. 6 in. by ¾ in.

(8) ? Reptilia.

31. A slab remarkable for the distinctness of the phalangeal impressions of a fossil animal as yet undetermined.

*32. A single track of *Anchisauripus minusculus*[2] E. Hitchcock. Size of slab 2 ft. 6 in. by 1 ft. 6 in. by 1⅜ in.

33. Various undetermined footprints. Size of slab 3 ft. 5½ in. by 2 ft. 6 in. by 1 in.

34. Footprint of a fossil animal, with a step of 2 ft. 4 in. Size of slab 3 ft. by 1 ft. 6 in. by ½ in.

35. Various undetermined footprints. Size of slab 4 ft. 2 in. by 2 ft. by 1 in.

36. Footprint of a fossil animal, with a step of 1 ft. 9 in. Size of slab 2 ft. 6 in. by 1 ft. 6 in. by 1 in.

37. Various undetermined footprints. Size of slab 4 ft. 7 in. by 2 ft. by ¾ in.

38. Various undetermined footprints. Size of slab 4 ft. 4½ in. by 2 ft. 6 in. by 1½ in.

39. Footprint of "*Anchisauripus expansus*."† Length of step 2 ft. 6 in. Size of slab 6 ft. 5 in. by 2 ft. by 1 in.

40. Various undetermined footprints. Size of slab 5 ft. 9 in. by 2 ft. 6 in. by 2¼ in.

*41. Footprint of *Eubrontes approximatus* (C. H. Hitchcock)[5].

42. Showing 5 rows of tracks made by *Anchisauripus sillimani* E. Hitchcock.[2]

43. Showing two *Anchisauripus* tracks in relief. Presented by Elliott Bradley. These are all called "*Brontozoum Sillimanium*" in E. Hitchcock's report but are referred to *Anchisauripus sillimanii* (E. Hitchcock[2] and *Anchisauripus hitchcockii* by R. S. Lull.[2] The type being the Middlefield slab 9-14 at Amherst. Obtained at Portland, Connecticut.

*44. Presenting three large tracks, "below the proper surface," said by T. M. Staughton to have been made by *Otozoum Moodii* E. Hitchcock.[9] Size of slab 8 ft. 6 in. by 2 ft. 6 in. by 2 in.

45. Various undetermined footprints. Size of slab 10 ft. 3 in. by 5 ft. 1 in by 2 in.

46. Showing a number of fossil footprints. "One of the

(9) An Orthopod Dinosaur, family Otozoidae.

odd tracks is that of a creature whose foot was like one's knuckle impressed into mud. Owing to infelicitous circumstances I failed to get the succession—and am not able to properly describe the track. It may be the same thing on Nos. 37, 38, 40, where the length of step can be determined."

*47. A footprint of *Anticheiropus pilulatus*[4] E. Hitchcock—the largest of all the tracks. "From Elijah Marsh's quarry in S. W. Montague—the locality whence the slabs were taken to Greenfield in 1835 where they attracted the comment of Mr. Draper—(See No. 70.) From this quarry my father, (Edward Hitchcock), obtained an impression and its cast in the early days but did not venture to name it until 1864 when he found a similar track of small size. This specimen I found at the same quarry in 1906 and though unsatisfactory it substantiates the existence of the earlier track. The Dartmouth specimen may be a fragment originally associated with certain specimens now at Amherst. The value of this track lies in its corroboration of the presence of a huge batrachian in the Trias. The relatives of that creature as known by their bones are all of small size like *Cheirotherium, Eryops, Mastodonosaurus* and the American Museum of New York people think there were none larger. *Otozoum*[9] for such reason is ruled out of Batrachian family though clearly allied to *Cheirotherium; Anticheiropus* is clearly allied to some of the Carboniferous amphibian tracks—and I say therefore *Anticheiropus* and *Otozoum* were amphibians as advocated for *Otozoum* by my father. This specimen is more symmetrical than the one at Amherst."

48. An undetermined impression.

*49. Footprints of *Platypterna deanii* E. Hitchcock[8]—"Abandoned by my father in the supplement without giving reasons—but this animal fits the old description fairly well."

50. Footprint of *Eubrontes giganteus* E. Hitchcock.[5]

51. A fossil footprint resembling No. 31.

52. Footprints of *Anomoepus*[6] and *Grallator*[1] in relief, associated with large ripple marks and fossilized wood. Size of slab 3 ft. 9½ in. by 2 ft. by 2¾ in.

*53. Various undetermined footprints. Size of slab 8 ft. 3 in. by 4 ft. 11½ in. by 2¾ in.

54. Exhibiting the bark of a tree near one corner—and just under the figure 54 a track of *Copeza* (*Lithographus*) sp.[10] "perhaps the one described elsewhere of an animal jumping about as if intoxicated." Size of slab 3 ft. by 1 ft. 6¾ in. by ¾ in.

*55. Tracks in relief of the old *Anchisauripus exsertus*[2] E. Hitchock and *tuberosus* (E. Hitchcock)[2] from Connecticut river bank below Smith's Ferry, Mass. Size of slab 2 ft. 6 in. by 1 ft. 6½ in. by 1 in.

56. Various undetermined footprints. Size of slab 4 ft. 8 in. by 3 ft. 4½ in. by 2 in.

57. Showing large ripple marks and smaller ones made across the first by a change in the currents before the mud became too hard to be impressed. This illustrates the belief of Professor Hitchcock that *Batrachoides* (*Koilosoma*) *nidificans* E. Hitchcock[4] is not to be explained as made by cross ripple marks. I found large surfaces of this sort in '06 and sent a slab like this one to Amherst." Size of slab 2 ft. 6 in. by 1 ft. 6 in. by 1⅜ in.

58. *Eubrontes divaricatus* (E. Hitchcock)?[5]

59. This number is missing from the collection.

60* and 61. Impressions representing *Mormolucoides articulatus* E. Hitchcock.[11] From about the upper part of the Horse Race, Gill, Massachusetts.

62. Illustrating the so called "frost marks" of Dr. Joseph Barratt, but according to E. Hitchcock produced through the agency of water or annelids. From Turners Falls, Massachusetts.

*63-64. Impressions of *"Clathropteris rectiusculus."*[12] From Easthampton, Massachusetts.

65-67. Footprints of Carboniferous Amphibia from Joggins, N. S.

68. A coprolite from the Lily Pond region.

---

(10) An insect track.

(11) Trail of a Neuropterid insect.

(12) One of the Filicales (Ferns).

69. Footprints of *Eubrontes approximatus* (C. H. Hitchcock).[5] From below Smith's Ferry, Northampton, Mass.

*70. *Steropoides diversus* (E. Hitchcock).[13] One of the first tracks sent by W. W. Draper to Dexter Marsh in 1835 (see lecture on Ichnology). Collected from the quarry at S. W. Montague, Massachusetts.

71. Another track of *Steropoides diversus* (E. Hitchcock).[13] From Gill below Turners Falls, Mass.

72. A portion of the track of *Otozoum Moodii* E. Hitchcock,[9] from South Hadley, Mass.

73-75. Footprints of Carboniferous Amphibia. Joggins, N. S.

76. Showing specimens of the imprints of *Lithographus hieroplyphicus* E. Hitchcock[10] and *Eubrontes*, sp.[5] From the Lily Pond region.

*77. Impressions of *Grammepus* sp.[7] and *Acanthichnus cursorius*.[16] E. Hitchcock.

78-79. Fossilized remains of various insects and worms.

80*-81. Small trifid tracks from the Gill side of the Connecticut River at Turners Falls. 81. (?) consists of "three tracks much like *Stenonyx lateralis* (E. Hitchcock).[5]" If so, data are afforded for further description of the species not to be found elsewhere.

*82. Footprint of *Batrachopus gracilior* (E. Hitchcock) (*Anisopus*, E. Hitchcock).[4]

83. An undetermined impression.

84. Impression resembling the bark of a conifer.

*85. Footprints suggestive of *Orthodactylus floriferus*, E. Hitchcock[14] and *Anchisauripus* sp.

86-87.* Impression representing *Halysichnus tardigradus* E. Hitchcock.[15] Brought from Lily Pond region in 1906.

88. Footprints of *Sillimanius gracilior* E. Hitchcock.[13]

*89. An impression representing *Lithographus heiroglyphicus* E. Hitchcock.[10]

---

(13) A Track of a bi-pedal reptile?

(14) Amphibian footprint?

(15) A worm trail.

90. A worm-like preservation resembling certain others at Amherst.

91. Tracks of *Acanthichnus* sp.(10)

92. A new track of *Grallator*.(1) From Turners Falls, Massachusetts.

93. Same as 90.

94. Tracks of an insect.

95. Embodying tracks suggestive of 90 and 93.

96. A quadrupedal impression of some unknown animal.

*97. Footprints of *Palamopus gracilipes*. (E. Hitchcock).(14) The one figured in Ichnology (Pl. 34)* lacks the distinct heel possessed by this specimen.

98. An unidentified fossil impression from Wethersfield, Connecticut.

99. A preservation resembling the veins of a leaf.

*100. A rather large foot print of *Exocampe ornata* E. Hitchcock.(14)

*101. Footprints of *Triaenopus Baileyi*. (E. Hitchcock).(10) From Wethersfield, Connecticut.

102. A fossil impression of unknown affinity from the north bank of Turners Falls.

*103. Tracks of *Acanthichnus cursorius* E. Hitchcock(10) and *A. trilinearis* E. Hitchcock(10) Lily Pond.

104. Insect tracks from Wethersfield, Connecticut.

105. An undetermined quadrupedal impression.

106. An undetermined track of a fossil animal.

*107. *Tarsodactylus expansus* C. H. Hitchcock.(16) This is the type specimen of this rare footprint. Collected near Greenfield, Mass. The only recorded locality.

108. Same as 88. E. Hitchcock.

109. Footprint of a *Grallator*.(1)

*110. An obscure track of *Acanthichnus punctatus* E. *Hitchcock*.(10)

111. This is apparently missing from the collection.

112. Professor Hitchcock notes this to be a "New species and genus of the intoxicated bug." See No. 54.

---

* Hitchcock, E. 1858, *loc. cit.*

(16) Quadrupedal reptile?

113. Insect tracks of various sorts.

*114. Tracks of *Lithographus heiroglyphicus* E. Hitchcock.[10]

*115. Footprints of *Argoides minimus* E. Hitchcock.[13]

116. Footprint of *Batrachopus gracilior*. (E. Hitchcock).[3] Compare with 82.

117. Footprint of *Palamopus gracilipes* (E. Hitchcock).[14]

118. Impressions of Raindrops.

*119. A very large footprint of *Anomoepus minimus* E. Hitchcock.[6]

*120. Track of *Koilosoma nidificans* E. Hitchcock.[14] From the typical locality at South Hadley, Massachusetts.

121. Showing plant remains resembling a palm leaf. From the Lily Pond region, 1906.

122. Other plant impressions from the Lily Pond region, 1906.

123-124. Plant impressions resembling *Dendrophycus*.[17]

125. An undetermined fossil impression from Wethersfield, Connecticut.

126. An undetermined impression.

127. Exhibiting two tracks in relief of *Grallator gracilis* C. H. Hitchcock.[1] This is the counterpart of slab 28.

*128. Tracks of fossil insects represented by *Conopsoides larvalis* E. Hitchcock—"an unusual jump;"[10] and *Acanthichnus cursorius*. E. Hitchcock.[10]

129. Missing.

130. *Anomoepus* sp.[6] and *Grallator gracilis* C. H. Hitchcock[1]—"Should be compared with slab 21." From the Dickinson Quarry, South Hadley, Massachusetts.

131. Plant remains collected from the Lily Pond region in 1906.

132-133. Irregular roundish impressions suggestive of *Koilosoma* sp. from the Lily Pond region, 1906.

134. Showing impressions of fish remains on the old Triassic beach mud.

---

(17) An algal like impression.

*135. Fossil ripples.

*136. Footprint of *Argoides macrodactylus* (E. Hitchcock) [13] from Chicopee, Massachusetts.

137. An undetermined impression.

138. Footprint of *Anchisauripus sillimani* E. Hitchcock.[2]

*139. A large slab illustrating *Unisulcus* (*Herpystezoum*) sp. (E. Hitchcock).[15]

140. Undetermined plant remains.

141. Footprints of a *Grallator*.[1]

142. Undetermined plant remains.

143. Footprint of *Anchisauripus sillimani* (E. Hitchcock) [2] showing the hallux. The other tracks on this slab have not been fully studied. This was the best specimen obtained at the Lily Pond in 1906.

144. Plant impressions from the Lily Pond regions, 1906.

145. A footprint of *Plesiornis*[18] obtained from Wethersfield, Connecticut.

146. An undetermined impression.

147. A footprint of *Anomoepus* sp.[6]

148. Impressions of Raindrops.

149. A footprint of *Anchisauripus* sp.[2] obtained from the Lily Pond region in 1906.

---

(18) Vertebrata, *incertae sedis*.

* There are also in the Dartmouth Collection excellent specimens of *Climatichnites wilsonii*, from the Potsdam sandstone (Upper Cambrian) of New York, collected by Professor William Patten from Bidwell's Crossing, Sciota, N. Y., and of *Dactyloidites Asteroides* from the Georgia slate of Swanton, Utah.

BOTANICAL GLEANINGS IN MICHIGAN—IV.

OLIVER A. FARWELL.

The botanical season opened up in Michigan about three weeks later in 1926 than it did in 1925 and somewhat later than in 1924. The first trip of the season was made May 5, to Britton, Lenawee Co., this being also the first visit to this county. The only woodland flowers seen were the Spring Beauty, Yellow Adder's Tongue, and Purple Cress, amongst the herbs, and the Box Elder, Spice Bush, and Prickly Ash amongst the woody plants. The Poplar and the Red Maple had passed the flowering stage and some of the willows were beginning to appear. Along the railway tracks, the Shepherd's Purse, Pennycress, Dandelion and Corn Gromwell were in bloom. At Newport, May 12, we explored an interesting piece of woods, the most interesting finds being the False Mermaid and the Harbinger-of-Spring, both of which covered acres of ground. Here, too, we found the Dwarf Ginseng, some plants of which had four leaves in the whorl.

After a two months seige of cystitis, botanizing was resumed July 14 in the vicinity of Ann Arbor. Getting back to the woods again was a very pleasant change. The Trumpet Flower was found as an escape; also *Berberis Thunbergii*. The former along the railway tracks and the latter in some oak woods. July 21 was the hottest day of the summer that we had thus far had, the mercury reaching 93° in the shade at 11:30 A. M. A pleasant breeze made the tramping more endurable than it otherwise would have been. On this day we were in Scio township and the outstanding discovery of the day was *Carex triceps* var. *hirsuta*. Vacation was spent in the Copper iDstrict of Michigan where *Potentilla Pensylvanica* was found and collected which perhaps is the first time it has been collected in Michigan.

At Copper Harbor, one of the finest harbors of refuge on Lake Superior, the waters of the harbor were seen to be very low, perhaps the water level was the lowest this year

in the memory of man. The harbor is protected from the ravages of the lake on the north by an island known as Porter's Island. The harbor is one half mile, more or less, across and over this distance from the mainland, the reef connecting Porter's Island with the mainland at Hunter's Point was seen to be above the surface of the water. It appeared to be at least four inches above water level which probably means six inches or more. My maternal grandfather, the late Mr. D. D. Brockway, went to Copper Harbor with his family in 1846 and built the first house there. His family was the first white family in the Copper District and his daughter, now Mrs. Sallie L. Scott, born at L'Anse, in 1844, was the first white child born in the mining districts of Michigan. I have heard him make the statement that when he first went to Coppen Harbor, he could walk from Hunter's Point to Porter's Island without getting his feet wet, which means that the water level in the late forties, especially 1847, was within 3 to 6 inches of being as low as it is now, (about 600 ft. 10 in., August 5, 1926), or possibly even as low as now. Porter's Island at the present time is not an island at all but a peninsula.

I have given considerable time to observations this summer, of *Corallorhiza maculata* and I find that all the parts ultimately turn brown; that the spotting of the perianth is variable and unreliable; that these color variations should be regarded as *forms* and not as *varieties;* that it is impossible to detect one from another after they have been dried and have become herbarium specimens except in the case of the var. *flavida* with a spotless lip; all forms with spotted lips are indistinguishable when dried. My observations show that at the beginning of flowering the sheaths are much the same color as the scapes or a little paler. When capsules are mature, the perianth and sheaths are brown. I collected at the same time late flowering specimens of var. *flavida* with yellow sheaths and mature fruiting specimens of the same with sheaths and withered perianth Van Dyke Brown; they had been growing side by side. Near by were the *typical form* of the species and the var. *intermedia* in all stages, at least

the sheaths and perianths were, from their normal colors to brown, depending upon the age or stage of growth. I have found var. *flavida* this summer with a spotted lip and I know that the plants Alexander reported from Birmingham as of this *variety* likewise had spotted lips. In Rhodora XXVII, 11-14, Mr. H. H. Bartlett is disinclined to accept his var. *fusca* as synonymous with var. *intermedia* and states that his var. with stem "light cinnamon drab" would hardly be described by any one as "exactly intermediate" between var. *flavida* (lemon-yellow) and the type (perilla purple.) If lemon yellow paint is mixed with an equal part of perilla purple paint, the "exactly intermediate" color thus produced will be "light cinnamon drab." The coloration then of the stems in each case is the same, the spotting of the perianth is variable and unreliable, and the brown of the sheaths is due to age: there seems to be no distinctions between vars. *intermedia* and *fusca* except change of color due to age.

Observations on the pods (generally miscalled "berries" which they are not any more than pea pods are) and pedicels of *Actaea* species as found in Michigan reveal that the pedicels of *A. rubra* may be red or green at the maturity of the pods which contain about 12 seeds; the pods are red (passing through crimson to carmine) or white. In *A. alba*, the specimens collected with green pedicels were immature and in all likelihood they would have been red if they had been allowed to grow to maturity; flowering and fruiting much later than *A. rubra;* pods smaller, 6 to 10 seeded. In *A. rubra* there may be as many as 40 pods to the ovoid or oval raceme; the most noted for *A. alba* was 28 on the long, linear-oblong raceme and the fewest noted was 5 on the short, oblong raceme. In *A. rubra* the pedicels are slender, about ¼ line thick and from 3 to 11 long but in f. *neglecta* the pedicels may be ½ line thick; in *A. alba*, the pedicels usually are ¾ to 1¾ lines thick and range from 3 to 9 in length.

Unisema or *Pontederia* for our Pickerelweed. In Rhodora, Vol. XXVII., page 76-81, Mr. Fernald gives a complete history of the founding of the genus *Pontederia* and prefers to retain it, as customarily done, for the *P. cordata.* But if

custom is wrong, custom should be righted. Fernald errs in endeavoring to make binomial nomenclature begin with 1737 instead of 1753 as required by the Vienna Rules (Art. 19). We are not concerned with what Linn may have thought either in 1737 or in 1754, but we are concerned with the Vienna Rules and their proper application to the Sp. Pl. (1753) and to the Gen. Pl. Ed. 5 (1754), *as we find them.* One of the generic characters is that of a 3-celled and many seeded fruit which Linn certainly did not obtain from P. *cordata;* therefore some other species (*P. hastata*) was equally involved in the generic description. As Linn was no tyro, the inclusion of the fruit characters in the generic description was not the result of chance but of deliberate intention, and as shown by Fernald was a part thereof *at all times.* As it is a well known fact that Linn had no types we can not say that Linn made either *P. cordata* or *P. hastata* the type of the genus. But one or the other must be construed as typifying the genus under the Vienna Rules. As fruit characters are primarily relied upon to determine the genera of this family of plants, fruit characters under the Vienna Rules (Art. 19) must be used to differentiate the genus; which makes *P. hastata* the type of *Pontederia.* No other conclusion is possible, provided you follow the Vienna Rules. Fernald falls back on Art. 5 to retain *Pontederia* in its customary sense; but again he errs for Art. 5 can not be invoked unless Art. 19 when applied fails to determine the type which, in the present instance, it does not do.

Late second blooming of *Ceanothus Americanus* was observed. Some withered and scorched flowering specimens of summer growth indicated that a fire had killed the early growth and that a second growth and late flowering was the result.

Where the year is not given, it is to be understood that the collectors are Farwell and Gladewitz and the year 1926.

Athyrium Filix-femina (L.) Roth, var. *Michauxii* (Spreng.) Clute. [var. *angustum* (Willd.) Farwell, Mich. Acad. Sci. VI. (1904) 201]. Goodison, No. 5374, Sept. 4,

1919; Farmington, No. 6068, Sept. 28, 1921; Utica, No. 6077, Oct. 5, 1921.

Athyrium Filix-femena var. *commune* (D.C.E.) Farwell. Oxford, No. 5515e, Aug. 22, 1920; Washington, No. 6007c, Sept. 14, 1921; Utica, No. 6077a, Oct. 5, 1921; Newport, No. 6226, July 5, 1922. A form with red stems and veins is forma *rubellum* (Gilbert) Farwell. Rochester, No. 5185, Oct. 6, 1918. Another variation with pinnules wide apart, oblique and decurrent is subv. *elegans* (Gilbert) n. comb. (*A. Filix-femina elegans* Gilbert). Utica, No. 6079, Oct. 5, 1921; Oxford, No. 6119, Oct. 12, 1921.

Potamogeton Illinoensis, Morong. Reported in the "Michigan Flora" from Manistee by F. P. Daniels. The plant, No. 6668, reported previously as *P. amplifolius*, belongs here.

Potamogeton Americanus, C. & S., var. *Novaeboracensis* (Morong) Benn. The plant, No. 4340, previously reported as *P. Americanus*, has the large, thick leaves of this variety and properly belongs here.

Elodea Canadensis Mx. Waterweed. Seldom seen in flower. Detroit R. at Detroit, No. 921a, June 13, 1900. A variety with linear, acute leaves is var. *angustifolia* (Muhl.) n. comb. (*Serpicula verticillata* var. *angustifolia* Muhl.) In Stony Creek at Parkedale, No. 3011, Aug. 4, 1912. Another variation with lance-oblong leaves is var. *Planchonii* (Caspary) n. comb. (*E. Planchonii* Caspary.) In Lake Orion, No. 921, Aug. 29, 1895 and in Lakeville Lake at Lakeville, No. 5328, July 20, 1919.

Bromus ciliatus Linn. A very variable species and many of its variations have been described as species, but the distinctions separating them are only those of degree and not of kind so that it is better to consider them as variations of one highly variable species than as several species. Keweenaw Co., Nos. 562 & 562a, Aug. 16, 1888; Orion, No. 562b, Aug. 29, 1895; Parkedale, No. 2852, July 14, 1912; Detroit, No. 562c, July 22, 1899. A variation with glabrous sheaths is subv. *denudatus* (Wieg.) n. comb. Keweenaw Co., No. 7485½, July 21, 1925. A variation with the lemmas pubescent all over is var. *purgans* (L.) A. Gr. Keweenaw Co., No. 563,

Aug. 26, 1887; Farmington, No. 5087, July 14, 1918; Parkedale, No. 2856, July 14, 1912; Rochester, No. 563a, July 4, 1896; Detroit, No. 683b, Aug. 18, 1907. A variation of this with smooth sheaths is subv. *laevivaginatus* (Wieg.) n. comb. Ypsilanti, No. 5246½, June 15, 1919; Portage Lake, No. 5837, June 12, 1921. A variation with pubescent glumes and overlapping hoary sheaths is var. *incanus* (Shear.) n. comb. (*B. incanus* Hitchc.) Franklin, No. 5161, Sept. 23, 1918; Ypsilanti, No. 5351, Aug. 31, 1919; Detroit, No. 2029, June 30, 1907; Rochester, No. 5194, Oct. 10, 1918; Goodison, No. 5378, Sept. 4, 1919. A variation of this with glabrous sheaths is subv. *latiglumus* (Scribn.) n. comb. (*B. latiglumis* Hitchc.) Detroit, No. 2026, June 30, 1907; Monroe Piers, No. 5570, Aug. 8, 1920; Ann Arbor, No. 7043, Aug. 20, 1924.

Bromus inermis Leyss. In moist grass lands at Geddes, No. 7777, Aug. 25, 1926.

Eragrosti Eragrostis (L.) Karst., var. *megastachya* (Koeler) Farwell, subv. *Leersioides* (Presl.) n. comb. (*Megastachya Leersioides* Presl.) A variation with a more open panicle and with some, often many, smaller, 2-6-flowered spikelets 5 mm. or so long. Shelbyville, No. 5953, July 31, 1921.

Triplasis purpurea (Walt.) Chapm. Sand Grass. This is common on the shores of Lake Erie in Monroe Co. over a stretch of several miles both north and south of Monroe Piers. No. 7799, Sept. 8.

Elymus Virginicus L. var. *hirsutiglumis* (Scribn.) Hitchc. Wild Rye. On the sand beaches of Lake Erie in Monroe township and county. Frequent. Rather small, not over 18 inches high. No. 7797, Sept. 8.

Asperella Hystrix (Linn.) Humb. Porcupine Grass. Common in woods everywhere in southeastern Michigan. Ypsilanti, No. 1174, July 23, 1891; Detroit, No. 1174a, July 21, 1892.

Asperella Hystrix var. *Bigeloviana* Fernald. Credited to Cheboygan Co., Mich. (*Ehlers* No. 557) by Fernald who points out that the variety does not occur at the same stations where the typical species has been collected. Since the publication of this variety in 1922, I have been looking for it continuous-

ly without success until now; everywhere it has been the typical form with smooth lemmas. Both forms are found at Detroit in the Redford district. No. 7811, Sept. 22.

Aira caespitosa Linn. Hair Grass. In *Rhodora* for Aug. (1926), Mr. Fernald revises this species (under *Deschampsia*) crediting it to this country and Canada in four varieties. The only one found in Michigan is *A caespitosa* var. *glauca* Hartm. Keweenaw Co., No. 717, Aug. 20, 1889 and No. 6260, June 29, 1923. To this variety he also refers *Baker, Earl and Tracy*, No. 982 from Hamor's Lake, Colorado; the plant under this number in the herbarium of Parke, Davis & Co., certainly is the var. *genuina* Reichb.

Aira flexuosa Linn. This species also occurs in Michigan but probably is less frequent. Keweenaw Co., No. 660, Aug. 16, 1888; Detroit, No. 660a, Oct. 14, 1906.

Sporobolus cryptandrus (Torr.) A. Gr., var. *involutus* Farwell. This variety with included panicles is abundant between Goodison and Orion. No. 7792, Sept. 1; also on the shores of Lake Erie in Monroe township and county, No. 7808, Sept. 8.

Sporobolus vaginifloarus (Torr.) Wood. Rush Grass. Fields at Detroit. Scarce. No. 7898, Sept. 22.

Agrostis stolonifera Linn., var. *stolonifera* (Sm.) Koch, f. *patula* (Gaud.) n. comb. (*A. patula* Gaud.) Similar to the variety but has violet flowers. On Belle Isle, Mich., in shallow water, No. 1811a, Aug. 29, 1903.

Muhlenbergia racemosa (Mx.) B. S. P., var. *ramosa* (Vasey) Beal. Wet fields at Detroit, No. 5624½, Aug. 29, 1920.

Spartina patens (Ait.) Muhl. The Salt Marsh Grass reported in the 19th Annual Report of the Mich. Acad. Sci. as *S. patens* var. *juncea* is not that variety, but is typical *S. patens*.

Panicum subvillosum Ashe. Portage Lake, No. 5847, June 12, 1921; Franklin, No. 5510, June 24, 1920; Washington, No. 5881, June 21, 1921. No. 5236, previously reported as *P. Tennesseense*, belongs here.

Panicum Tennesseense Ashe. Ypsilanti, No. 5237, June 15, 1919; this was previously reported as *P. Tsugetorum*.

Panicum macrocarpon Torr. No. 7416, previously reported as *P. Liebergii* belongs here.

Panicum virgatum Linn, var. *Cubense* Griseb. A form that seems to fit this variety was collected at Imlay City, No. 6687, Aug. 5, 1923.

Eriophorum spissum Fernald. Cotton Grass. The plants previously reported as *E. vaginatum* vars. *opacum* and *humile* belong here.

Carex triceps Mx., var. *hirsuta* (Willd.) Bailey. According to Beal in Michigan Flora, this sedge is known in Michigan only from one station in Ionia Co. We found it in an oak woods at Scio, which makes a second station. No. 7736, July 21.

Carex gigantea Rudge. (*C. lupuliformis* Sartw.) Excellent specimens of this sedge were collected in a shallow depression in an oak woods at Scio. It was the first time I had seen it in its typical form in Michigan. No 7732, July 21.

Juncus Bogotensis H. B. K., N. Gen. et Sp. Pl., 1 (1815) 235. *J. effusus Linn., var. b.* Sp. Pl., Ed. 1 (1753) 326 *J. effusus* Linn, var. *a*, Fl. Suec., Ed. 2, (1755) 111. The modern interpretation of the Linnaean *J. effusus* dates from the Flora Suecica of 1755; this of course is contrary to the Vienna Rules which makes the Sp. Pl., 1753 the beginning of binomial nomenclature. The variety *a* of the latter is the var. *b* of the former and is the species described by Willdenow as *J. arcticus* which name should give way to the older one of Linn. The var. *b* of the Sp. Pl. of 1753 is the var. *a* of the Fl. Suec. of two years later and is the species which has so generally been known under the Linnaean name but which according to the Vienna Rules must be known under the name heading this paragraph. Abundant throughout Michigan in swampy grounds and on the borders of streams. Keweenaw Co., No. 465, Aug. 30, 1886; Detroit, No. 465c, July 10, 1893.

J. Bogotensis var. *compactus* (Lej.& Court.) n. comb. Inflorescence contracted into a small, dense, spherical head. Ke-

weenaw Co., No. 465a, Aug., 1900 and No. 7488, July 21, 1925; Detroit, No. 465b, July 10, 1893.

Cypripedium bulbosum Mill., var. *pubescens* (Willd.) n. comb. (*C. pubescens* Willd.) This is the variety with the largest flower and has the sac compressed vertically giving it the appearance of a "moccasin," hence the name "Moccasin Flower." The three, yellow Ladies' Slippers are undoubtedly conspecific, the oldest name for which is *C. bulbosum* Miller. The typical form is that which was described by DeCandolle as *C. flavescens*, in this the sac is compressed laterally, that is, the force of compression is exerted in a horizontal direction making the sac more bulbous in appearance than is the case in the other forms where the compression is vertical.

Calopogon pulchellus (Salisb.) R. Br. in Ait. f. Hort. Kew. V (1813) 204-5. Grass Pink. In Rhodora Vol. XXVII, pages 193-196, Mr. K. K. Mackenzie endeavors to show that the name *Limodorum tuberosum* Linn, Sp. Pl., Vol. 2 (1753) 950 should be used instead of *Calopogon pulchellus* for the Grass Pink. But Mackenzie makes two mistakes: (1) in claiming Linn named and described the species from *Clayton's* plant No. 76 which he had before him and (2) in ignoring that nomenclature begins in 1753. When Linn drew up his manuscript for *Limodorum tuberosum* for the Sp. Pl., it is extremely doubtful if he even knew that the Clayton specimen was in existence much less having it before him. This manuscript was based upon and taken from publications, not from specimens in Linn's herbarium. True, *after the publication of the Sp. Pl.*, he took that work and went over his herbarium indicating upon the sheets the appropriate species to which they were to be referred; but this can not in any way make such specimens the types of species published in the Sp. Pl. In the publication of *Limodorum tuberosum* L. Sp. Pl. (1753) 950, there is *but one description given* and this fact alone determines the application of the name, as against other references cited by title only, which may or may not be the same. Also the specific name manifestly is taken from Martyn's description which does require that the

binomial be applied to Martyn's species, Mackenzie to the contrary notwithstanding. The description of the species is from Martyn whose plate 50 also is cited so that "*Limodorum tuberosum* Linn" cannot apply to any other plant than Martyn's no matter what "*Limodorum* Gronovius" Fl. Va. (1739) 110, may have been. The Grass Pink is common in Michigan. It is found in bogs, meadows and even in the moist sand of roadside ditches. Keweenaw Co., No. 490, Sept. 12, 1886; Parkedale, No. 2789, June 30, 1912; Algonac, No. 3689, June 20, 1914; Marl lake, No. 4285, July 9, 1916; Orion, No. 5058, July 7, 1918.

Corallorrhiza maculata Raf. Coral Root. In rocky woods at Copper Harbor. Stems perilla purple, sheaths about the same, some with upper parts brown, No. 7751, Aug. 5, 1926.

Corallorrhiza maculata f. *flavida* (Peck) n. comb. [*C. multiflora* Nutt., var. *flavida* Peck N. Y. State Mus. Rep. L. (1897) 126]. Whole plant yellow except the white lip which may or may not be spotted. Lip unspotted and sheaths yellow, Copper Harbor, No. 7757½, Aug. 5, 1926; lip unspotted, sheaths Van Dyke Brown, capsules mature, Copper Harbor, No. 7750, Aug. 5, '26. Lip spotted, sheaths yellow, Goodison, No. 7788, Sept. 1.

Corallorrhiza maculata f. *intermedia*, n. f. (*C. maculata* var. *intermedia* Farwell; *C. maculata* var. *fusca* Bartlett.) Plant intermediate in color between the typical species and the f. *flavida*, i. e., light cinnamon drab. Rocky woods at Copper Harbor, No. 7749, Aug. 5, 1926; moist woods at Goodison, No. 7787, Sept. 1. With No. 7788. Pitsfield, No. 7829, Sept. 29.

Salix pentandra Linn. Planted largely as a roadside shade tree at Orchard Lake. In good fruiting condition Oct. 6, No. 7846.

Hicoria microcarpa (Nutt.) Britt. Hickory. Orchard Lake. No. 7837, Oct. 6. Previously at Detroit, No. 1628, June 2, 1899; Long Lake, No. 6075, Oct. 4, 1921.

Morus rubra Linn. Red Mulberry. This is a native tree distinguished from the next by its dull, rough leaves, S.

Rockwood, No. 4790, Oct. 26, 1917; Linden, No. 6665, Aug. 1, 1923.

Morus alba Linn. White Mulberry. An escape near Ann Arbor where young trees are plentiful along fences and on the railway right of way. Fruit purple. No. 7718, July 14. This purple fruited form is frequent at Detroit, No. 3960, May 31, 1915; Grosse Pointe, No. 1821, July 13, 1904. The form with white fruit was collected at Ypsilanti, No. 1116, May 23, 1891; Ann Arbor, No. 7727, July 14, 1926; and at Detroit, No. 7728, July 15, 1926. The var. *Tartarica,* Loudon was collected at Detroit, No. 4869, May 26, 1918 and No. 4959a, June 22, 1918; Monroe Piers, No. 5488, June 30, 1920.

Humulus Lupulus L., var. *Neo-Mexicanus* (Nels. & Cockr.) Rydb. Hops. On banks at Superior, No. 7776, Aug 25, 1926.

Parietaria Pennsylvanica Muhl. Pellitory. In oak woods north of Ann Arbor. No. 7721, July 14.

Commandra umbellata (L.) Nutt. Everywhere on rather dry grounds in open fields or in woods, Keweenaw Co., No. 233, June 20, 1885; Oxford, No. 6522 and Goodison No. 6521, June 6, 1923; Geddes, No. 7377, May 27, 1925; Ann Arbor, No. 7379, May 27, 1925; Algonac, No. 7418, June 17, 1925; Detroit, No. 233a, June 2, 1893 and No. 1893, May 23, 1905.

Commandra Richardsiana Fernald. In similar situations. The following numbers from the color and venation of the leaves apparently belong here. Eagle Harbor, Nos. 6627, 6628, June 29, 1923; Copper Harbor, No. 7756, Aug. 5, 1926; Monroe, No. 7306, April 29, 1925; Eloise, No. 7360, May 20, 1925; Ypsilanti, No. 7366, May 27, 1925; Commerce, No. 7388, June 3, 1925; Nankin, No. 7411½, June 10, 1925.

Polygonum achoreum S. F. Blake. Bluish green. Sepals white-bordered and in fruit some of them are rosy-margined. Large leaves on juvenile plants often attain a size of 3 inches in length (of which 5 lines represent the petiole) and 1.25 inches in width. Moist sandy grounds at Ypsilanti, No. 7775a, Aug. 25, 1926; Detroit, No. 7779, Aug. 26, 1926; Belle Isle, No. 291b, Sept. 3, 1892; Ypsilanti, No. 291a, Sept. 8, 1891; Keweenaw Co., No. 291, Aug. 1, 1885. Collections be-

fore 1926 were made as *P. erectum* which species I have not yet seen from Michigan.

Polygonum dumetorum Linn, f. *cristatum* (Engelm. & Gr.) Robinson. False Buckwheat. This is common on the shores of Lake Erie in Monroe township and county. No. 7805, Sept. 8.

Chenopodium ambrosioides Linn. American Wormseed. At Monroe Piers. This is the first time it has been observed outside of Wayne Co. No. 7796, Sept. 8. Previously collected at Detroit, No. 1959, Oct. 2, 1905, No. 5153, Sept. 20, 1918 and No. 5397, Oct. 15, 1919.

Chenopodium ambrosioides var. *anthelminticum* (Linn) A. Gr. Detroit. No. 1482, Sept. 6, 1894; Birmingham, No. 5215, Oct. 13, 1918.

Salsola Kali Linn. Saltwort. Along railways. Scarce. Pittsfield, No. 7824, Sept. 29.

Amaranthus hybridus Linn. Green Amaranth. Spikes thick and short, erect, obtuse, resembling those of *A. retroflexus* but greener, longer, and not so stiff. Stems yellowish, essentially glabrous. Detroit, No. 7816, Sept. 22. We collected this nearby, Oct. 8, 1924, No. 7247, (see vol 9, p. 268); Royal Oak, No. 4558½, Sept. 8, 1917.

Amaranthus hybridus var. *chlorostachys* (Willd.) Beck. Spikes more slender and elongated with drooping apex, acute. Stems greenish, pubescent. Detroit, No. 1330, Sept. 7, 1892, [see 20th Mich. Acad. Sci. Rept. (1918) 175 where reported as *A. hybridus*] and No. 5136, Sept. 15, 1918; also No. 6380, Aug. 28, 1922; Monroe, No. 6718, Aug. 22, 1923; Marine City, No. 6728, Aug. 29, 1923.

Acnida Tamariscina (Nutt.) Wood. Water Hemp. In railroad yards at Detroit. Looks like *A. tuberculata* from which it can be distinguished only by fruit characters. No. 7899, Sept. 22.

Silene Armeria Linn. Sweet William Catchfly. Shores of Torch Lake at Lake Linden. The petals of these plants are retuse rather than emarginate. No. 7740, Aug. 2, 1926.

Silene latifolia (Mill.) Britten and Rendle. Bladder Campion. The calyx is beautifully veined, often in colors. Spread-

ing. Lake Linden, No. 7760, Aug. 8, 1926. I have collected it at Detroit, No. 1819, July 5, 1904; Rochester, No. 3877, Sept. 7, 1914; Royal Oak, No. 5585, Aug. 12, 1920; Ypsilanti, No. 5290, July 13, 1920. *Gladewitz and Farwell* have collected it at Oxford, No. 6511, June 6, 1923; Erie, No. 6641, July 11, 1923; Amy, No. 6976½, July 16, 1924.

Stellaria media (Linn) Cyrill, var. *maxima* (Schur) Gürke. Chickweed. A large, fleshy plant resembling *S. aquatica* from which it is distinguished by its three styles. Wet grounds along the shores of Torch Lake at Lake Linden, No. 7741, Aug. 2, 1926. The plant from Redford, No. 4573, previously reported as var. *succulenta* belongs here.

Stellaria media var. *triandra* (Schur) Baguet. A common form in cultivated grounds, weak and straggling, most of the leaves roundish ovate on long ciliated petioles. Lake Linden, No. 7743, Aug. 2, 1926.

Stellaria media var. *Holosteiformis* (Schur) Gürke. Firmer, upright, a foot or so high, most of the leaves ovate-oblong and sessile. Waste grounds, Lake Linden, No. 7742, Aug. 2, 1926.

Anychia Canadensis (L.) B. S. P. Forked Chickweed. In oak woods north of Ann Arbor. No. 7722, July 14.

Actaea alba (L.) Mill. White Baneberry. The pedicels are thick and the mature pods are white. Keweenaw Co., No. 101, June 6, 1884; Walled Lake, No. 4491, June 5, 1917. Red pedicels: Zoo Park, No. 4413, Aug. 27, 1916; Dearborn, No. 5602a, Aug. 15, 1920; Detroit. No. 7809, Sept. 22; Goodison, No. 7786, Sept. 1. The following are green pediceled: Detroit, No. 101a, July 16, 1892; Dearborn, No. 5603, Aug. 15, 1920; Almont, No. 6275b, July 19, 1922; Eagle River, No. 7765, Aug. 11, 1926; Goodison, No. 7784, Sept. 1.

Actaea rubra (Ait.) Willd. Red Baneberry. The pedicels are slender and the mature pods are carmine. Keweenaw Co., No. 102, June 26, 1884; Detroit, No. 102a, May 20, 1893; Walled Lake, No. 4492, June 15, 1917. Red pedicels: Detroit, No. 1461½, June 24, 1894; Farmington, No. 5086, July 14, 1918. Green pedicels: Detroit, No. 1720½, July 2, 1901;

Parkedale, No. 3509, July 20, 1913; Rochester, No. 3723, July 19, 1914.

Actaea rubra f. *neglecta* (Gillm.) Robinson. The pods are white. Redford, No. 5433, May 23, 1920. Pedicels red: Keweenaw Co., No. 781, Aug. 1, 1890; Detroit, No. 781a, Sept. 10, 1896. Pedicels green: Eagle River, No. 7764, Aug. 11, 1926.

Actaea rubra var. *gigantea* Gates. Merely a large form and being based entirely upon size, it is not worth being maintained. Plants as high as 38½ inches. Goodison, No. 7785, Sept. 1 (red pedicels).

Berberis Thunbergii DC. Barberry. The cultivated form has brown branches. Found as an escape north of Ann Arbor, but in this wild situation the branches are green. No. 7724, July 14.

Alyssum Alyssoides (L.) Gouan f. *albineum* n. f. The typical form of the species has yellow flowers fading white. This form has white flowers. Waste places at Shelbyville, No. 6579, June 21, 1923.

Erysimum Irio (L.) n. comb. [*Sisymbrium Irio* Linn, Sp. Pl. (1753) II, 659]. London Rocket. In waste grounds at Detroit, No. 7730, July 19, 1926. Rare.

Erysimum Loesellii (L.) n. comb. [*Sisymbrium Loesellii* Linn, Amoen. Acad. (1759) IV, 279]. With the preceding. No. 7731, July 19, 1926. The first species is glabrous and has the young pods overtopping the flowers. This is hispid and has the young pods shorter than the flowers.

Raphanus sativus Linn. Radish. Waste grounds, Ypsilanti, No. 7774, Aug. 25, 1926.

Heuchera hirsuticaulis (Wheelock) Rydb. Alum Root. Hillsides at Scio. Just passing out of its flowering season. Not included in Beal's Michigan Flora. Scio, No. 7738, July 21. Other stations are Wiard, No. 2159, June 25, 1910; Parkedale, No. 2744, June 23, 1912; LaSalle, *Farwell and Gladewitz*, No. 5766, June 2, 1921.

Mitella diphylla Linn, f. *triphylla*, Rosendahl. This form with a third sessile leaf on the scape between the usual op-

posite pair and the inflorescence was collected at Redford, No. 4852, May 24, 1918.

Mitella diphylla Linn, f. *efoliata* n. f. Scape without leaves or with minute vestiges of them. In copses at Bloomfield, No. 4866, May 25, 1918.

Spiraea tomentosa Linn, var. *rosea* (Raf.) Fernald. Hardhack. All that I have seen of this species from Michigan belongs to this variety. Royal Oak, No. 4326, July 13, 1916 and No. 5592a, Aug. 12, 1920; LaSalle, No. 6285, July 26, 1922; Detroit, No. 1545, July 23, 1896; Dead Lake, No. 1545a, July 10, 1910.

Potentilla Pensylvanica Linn. Five Finger or Cinquefoil. Torrey and Gray say it does not occur in the U. S. east of the Mississippi river. Dr. Beal admitted it to the "Michigan Flora" on the strength of Gray's Manual which cites "Lake Superior." It was not here in the '80's when I lived here nor as late as in 1915; but it has appeared sometime since the last named date. Britton, also Rydberg, says the styles, thickened and glandular at the base, are not longer than the mature glabrous achenes. In these plants the styles are ½ as long again as the achenes. They have tap roots with caespitose crown. The stems are appressed pubescent; the leaves grayish pubescent beneath, green above with more or less appressed hirsutenes. The leaves are old pinnate with 5-9 leaflets, the leaflets approximate and subdigitate or remote, usually opposite but sometimes alternate; leaves of the stem usually small and pentagonal, the lowermost and the basal similar or larger and obovate from the more remote leaflets. The obovate leaflets are pinnatified to near the midrib with oblong or linear, obtuse lobes, distinctly revolute, the larger leaflets are often 3 inches long by 1 inch wide, often with 1 or 2 teeth on the outer margin of the lobes. Plentiful over a stretch of ground 200 yards in length by 40 wide; cattle had browsed upon most of it. Clifton, No. 7769, Aug. 11, 1926.

Rubus strigosus Mx. Red Raspberry. Abundant on the Keweenaw Peninsula. This has bristly gladular calyx lobes and a bristly brownish somewhat glaucous stem; leaves ser-

rate. Keweenaw Co., No. 263, July 15, 1885; Detroit, No. 263a, July 10, 1893.

Rubus Phoenicolasius Maxin. Wineberry. This has a glauceous, reddish stem with long reddish, more or less glandular hairs, and the leaves are apiculately crenate. Roadsides at Goodison, No. 7780, Sept. 1; previously at Trenton, No. 5784, May 26, 1921; Detroit, No. 3372, May 24, 1913.

Rubus neglectus Peck. Purple Raspberry. Much like the Red Raspberry but the stems are purple and glaucous and the fruit is purplish red. Low grounds, Pittsfield, No. 7836, Sept. 29; previously at Northville, No. 6465, Oct. 18, 1922; Marl Lake, No. 5713, Sept. 18, 1920; Detroit, No. 1403, July 25, 1893.

Rubus occidentalis Linn. Black Raspberry. Stems are densely white glaucous and prickly with stout hooked prickles. Fruit black. Dearborn, No. 7507, Aug. 6, 1925, reported as *R. neglectus* belongs here. Ypsilanti, No. 1120, May 29, 1891; Detroit, No. 1120a, June 6, 1893 and No. 3373, May 24, 1913; Parkedale, No. 2681, June 11 and No. 2943, July 28, 1912.

Rosa acicularis Lindl., var. *Sayiana* Erlanson. Prickly Rose. Previously reported as *R. Engelmanni* S. Wats. It is abundant on the Keweenaw Peninsula. The fruit is pear shaped, often with a very long, tapering base, and frequently tapering to the apex. Vaughnsville, No. 779, Aug. 1, 1890; Eagle Harbor, No. 7580, Aug. 5, 1925; Copper Harbor, No. 7755, Aug. 5, 1926.

Rosa acicularis var. *rotunda* Erlanson. Abundant on the Keweenaw Peninsula. It heretofore has been reported as var. *Bourgeauiana*. The fruits are sometimes flask shaped. Clifton, No. 187, Aug. 22, 1884, and No. 7482, July 21, 1925; Copper Harbor, No. 1614a, Aug. 24, 1898 and No. 7754, Aug. 5, 1926; Eagle River, No. 7486a, July 21, 1925.

Rosa acicularis var. *Bourgeauiana* Crepin. Abundant on the Keweenaw Peninsula. Heretofore reported as *R. acicularis* Lindl. Copper Harbor, No. 5970, Aug. 16, 1921, and Nos. 7753, Aug. 5, 1926; Eagle Harbor, No. 7581, Aug. 15, 1925.

Rosa suffulta Greene. A large stand of this rose was

found north of Ann Arbor on dry ground near the railroad tracks. No. 7726, July 14.

Rosa cinnamomea Linn. Cinnamon Rose. Persistent and spreading. A double flowered form. In the rear of my home at Clifton, back in the eighties, was a well-kept small garden composed of cherries, currants, strawberries and perhaps a half dozen plants of this rose. Today there is no sign or indication of this garden except this rose and some cherry tree stumps. The old garden has disappeared and has been converted into an excellent green pasture or grassy field. The roses probably have had no cultural attention for more than a quarter century but have spread until they have formed a dense stand of several score plants. No. 7770, Aug. 11, 1926.

Pyrus Arbutifolia (*Linn*) *Linn* f. Chokeberry. Fruit small red, 2-3 lines in diameter. Leaves densely tomentose beneath, obovate or oblanceolate, 0.75 to 3.00 by 0.375 to 1.625 inches, abruptly short acute. A single shrub, about 6 feet in height, with two or three slender stems. In a Tamarack swamp at Orchard Lake. This is the first time that I have detected the typical form of the species in Michigan. No. 7811, Oct. 6. In the herbarium of Parke, Davis & Co., there is a plant from Eustic, Fla., G. V. Nash, No. 3, March 12-31, 1894 which has smaller, oval or oblong leaves (1.25-1.75 by 0.5-0.75 inches) broadly rounded at the apex which may be known as *Pyrus Arbutifolia* var. *oblongifolia*, n. var.

Pyrus arbutifolia var. *atropurpurea* (Britt.) Robinson. The leaves are much as in the species but nearly glabrous beneath. Fruit larger (4-5 lines in diameter) and purple. In the same swamp, but frequent. No. 7845. This variety is abundant but not so much so as *P. melanocarpa* (Mx.) Willd. which has glabrous leaves of the same shape but somewhat smaller and black fruit intermediate in size (3-4 lines.)

Crataegus straminea Beadle. (*C. apposita* Sarg.) Thorn Apple. An irregularly topped shrub 4 to 8 feet high. At this time the fruit was green but about fully grown, mostly single but with an occasional cyme of 4 or 5 fruits which looked more like umbells than cymes. The calyx lobes are mostly deciduous, only a very few fruits were seen that were

still capped with their calyx lobes. Scio, No. 7735, July 21.

Crataegus coccinea Linn, var. *Ellwangeriana* (Sarg.) Eggls. Frequent in fields at Detroit, No. 7820, Sept. 22.

Melilotus Melilotus-officinalis (L.) Farw. Yellow Sweet Clover. The typical form with upright stems and divergent branches. Pittsfield, No. 7833, Sept. 29.

Linum usitatissimum Linn. Flax. Roadsides, Ypsilanti, No. 7775, June 25, 1926.

Euphorbia dentata Mx., var. *lancifolia* Farw. Railway banks, Pittsfield, No. 7830, Sept. 29.

Impatiens aurea Muhl. Yellow Jewelweed. In moist, shady grounds along the shores of Lake Erie in Monroe township. No. 7804, Sept. 8. Previously collected at Detroit, No. 1871, Sept. 9, 1904, and at Galesburg, No. 5554, July 20, 1920.

Impatiens biflora Walt. Jewelweed. Similar situations and with the last, but also in more open places, often on the sand beach. No. 7803. Previously collected in Keweenaw Co., No. 366, June 1, 1886; at Detroit, No. 366a, July 16, 1892; Parkedale, No. 2945, July 28, 1912 and No. 3145, Sept. 2, 1912; Calumet, No. 3094, Aug. 26, 1912.

Impatiens biflora Walt., f. *immaculata* C. A. W. On the sand beach of Monroe township. Rare. No. 7802, Sept. 8.

Impatiens Balsamina Linn. Balsam. An escape to waste grounds at Detroit, No. 1596, Sept. 4, 1897.

Ceanothus Americanus L. New Jersey Tea. Both flowers and fruit were abundant. Pittsfield No. 7822, Sept. 29.

Malva sylvestris Linn. High Mallow. On the shores of Torch Lake at Lake Linden. Scarce. No. 7772, Aug. 14, 1926.

Gentiana flavida A. Gr. Fields at Pittsfield, No. 7831, Sept. 29.

Acerates viridiflora, Ell., var. *lanceolata* (Ives) A. Gr. Green Milkweed. Grassy fields, Pittsfield, No. 7826, Sept. 29.

Monarda fistulosa L., f. *albescens* Farwell. A new station for this white flowered form was discovered at Goodison. No. 7790, Sept. 1.

Solanum Dulcamara L., var. *pubescens* R. & S. We found

a stand of this variety with exceptionally dense pubescence throughout at Scio. No. 7733, July 21.

Lycopersicon Lycopersicum (L.) Farwell, var. *commune* (Bailey) n. comb. [*L. esculentum* Mill., var. *commune* Bailey, Man. Cult. Plants (1924) 656]. Tomato. This seems to be well established and naturalized on the shores of Lake Erie in Monroe township and county; it is frequent along several miles of wild coast, ripening considerable fruit. No. 7800, Sept. 8, 1926.

Verbascum Blattaria L., f. *albiflorum* (O. K.) n. comb. Flowers white with a tinge of purple. As this is only a color variation it should rank as a form. Pittsfield, No. 7823, Sept. 29.

Tecoma radicans (L.) DC. Trumpet Flower. This is quite common in cultivation near houses and fences. A number of plants were found on the banks of the Ann Arbor railroad where they are a natural escape from cultivation, the first time observed away from the influence of a house or garden. No. 7717, July 14.

Lonicera Morrowii A. Gr. A cultivated species of honeysuckle at Grosse Pointe. In July 1 was given a sample of a fruiting honeysuckle with the information that a two years old son of Mr. Glenn Howland of Grosse Pointe had made a meal out of the berries of the shrub. The result of eating a quantity of the fruit was the appearance on the boy of a copious rash or urticaria which disappeared again in due course leaving no bad after effects. The specimen proved to be of this species. The plant, No. 7364, from Ypsilanti previously reported as of this species is *L. Xylosteum* L. Other species that are suspected are *L. crysantha, L. involucrata, L. japonica, L. Tartarica, L. tomentella* and *L. Xylosteum*.

Lobelia Kalmii L., var. *capillaris* n. var. Stem simple, slender, weak, capillary, lower leaves linear-oblanceolate, three quarters of a line wide, uppermost usually filiform, flower usually one, smaller (3 to 4½ lines) and paler than in the species. Wet grassy meadows near Goodison, No. 7794, Sept. 1.

Sicyos angulatus L. Bur Cucumber. Common along the

sand beaches of Lake Erie in Monroe township and county. No. 7798, Sept. 8. A few plants each of some species of *Citrullus* and of *Cucurbita* were observed, probably *Cit. vulgaris* and *Cuc. Pepo.*

Solidago caesia Linn. Goldenrod. A handsome, paniculately branched species of dry deciduous woods. Frequent. Orion, No. 917, Aug. 29, 1895; Oxford, No. 4725, Oct. 11, 1917; Utica, No. 6094, Oct. 5, 1921.

Solidago caesia var. *axillaris* (Ph.) A. Gr. Stems simple, inflorescence consists of small glomerules in the axils of the leaves. Frequent. Orchard Lake, No. 7838, Oct 6. Previously at Oxford, No. 4726, Oct. 11, 1917; Utica, No. 6095, Oct. 5, 1921.

Solidago bicolor L., var. *concolor* T. & G., f. *ramosior* Farwell. Roadsides at Goodison. No. 7782, Sept. 1. This has been observed at Rochester.

Solidago pulcherrima A. Nelson. Dry soils. Pittsfield, No. 7828, Sept. 29.

Aster sagittifolius Weden., var. *glomerellus* n. var. Stems red, glabrous, about a yard in height, leaves rough on both sides, ovate lanceolate, sagittate or cordate, on broadly margined petioles, the upper lanceolate, tapering into the broadly margined petiole or sessile, inflorescence, usually more than half the plant, reduced to small glomerules in the axils of the leaves generally less than the length of the leaf; rays white. It looks much like a reduced form of the var. *urophyllus* but the leaves are rough underneath instead of pilose. Abundant. Pittsfield, No. 7821, Sept. 29, 1926. Typical *A. sagittifolius* with paniculate inflorescence and blue rays is scarce in southeastern Michigan; collected at Redford district of Detroit, No. 7810, Sept. 22. The common form here is the white rayed variety *urophyllus* with a narrow thyrsoid inflorescence of both terminal and axillary elements. The differences appear to be specific and I would restore it to specific rank as *A. urophyllus Lindl.* The above described variety would then be *A. urophyllus* var. *glomerellus.*

Helianthus giganteus Linn, var. *resiniferus* n. var. The lower surfaces of the leaves are copiously covered with large,

yellow, resinous globules. In low, wet grounds at Parkedale, near Rochester, No. 3846, Aug. 23, 1914.

Helianthus giganteus Linn, var. *verticillatus* n. var. The leaves on the upper part of the stem are arranged in whorls. Shores of Marl Lake near Orion, No. 4369, Aug. 13, 1916.

Cirsium undulatum (Nutt.) Spreng., forma *album* n. f. Flowers white. The typical species has reddish purple flowers but as these flowers are pure white the plant may receive a formal name as a color variation. North of Ann Arbor, No. 7725, July 14.

Centaurea Cyanus Linn. Bachelor's Button. Waste grounds, Ypsilanti, No. 7773, Aug. 25, 1926.

Sonchus arvensis L., var. *maritimus* Wahl. Sow Thistle. Pittsfield, No. 7834, Sept. 9.

Sonchus oleraceus Linn. Sow Thistle. There are three distinct varieties of this species as to leaf form. The typical form has a runcinate leaf with broad lateral lobes, the terminal larger, suborbicular. Marine City, No. 6725, Aug. 29, 1923. Var. *lacerus* (Willd.) Wallr. has pinnatifid leaves, all the lobes narrower lanceolate and subequal. Marine City, No. 6724a, Aug. 29, 1923. Var. *integrifolia* Wallr. has entire leaves, the upper oblong, oval or lanceolate, the lower with a large terminal deltoid lobe and a broadly winged midrib usually without lobes. Marine City, No. 6723a, Aug. 29, 1923.

Hieracium umbellatum Linn. var. *scabriusculum* n. var. Lower part of stem more or less hispid, upper part puberulent, uppermost part and peduncles canescent, leafy up to the inflorescence, leaves not reduced in size; involucre pubescent. This is the plant that has passed current as *H. umbellatum* L. or *H. scabriusculum* Schwein. Such European specimens of *H. umbellatum* as I have seen have the leaves on the upper parts of the stems reduced to small bracts, the involucres are glabrous, and the stems are much less pubescent above and usually glabrous below. Frequently the uppermost part of the stem is leafless, giving the inflorescence the appearance of being peduncled. Our plant would appear to be a good geographical variety. Copper Harbor, No. 7748, Aug. 5, 1926.

—Dept. of Botany, Parke, Davis & Co., Detroit, Mich.

ON THE DIVISION OF THE SPHAERIIDAE INTO TWO SUBFAMILIES: AND THE DESCRIPTION OF A NEW GENUS OF UNIONIDAE, WITH DESCRIPTIONS OF NEW VARIETIES.*

FRANK COLLINS BAKER

University of Illinois

In 1895, Dall called attention to the difference in siphonal arrangement between Sphaerium and Pisidium, and said "If this is found by more extensive observation to be constant within the genera the family might be divided into two subfamilies (Wagner Free Inst. Sci., III, p. 540). The examination of upward of a hundred species of these two genera, together with many species of Musculium, seem to attest the accuracy of Dall's suggestion and the propriety of separation into two groups or subfamilies. Hannibal (Proc. Mal. Soc. London, X, p. 133, 1912) has instituted a family Corneocycladidae for the small clams known as Pisidium, but the name will have to be ignored since no characteristics of importance are given in the diagnosis.

Subfamily SPHAERIINAE Nov.

A distinct anal and branchial siphon; anterior end shorter than posterior end.

This group will include the genera Sphaerium, Musculium, and Eupera.

Subfamily PISIDINAE Nov.

Anal siphon only developed, the branchial siphon being represented by the mantle cleft; anterior end longer than posterior end.

This group includes the genus Pisidium. The foot of Pisidium differs from that organ in the Sphaeriinae in being

* Contribution from the Museum of Natural History, Univeristy of Illinois, No. 40.

larger in proportion to the size of the animal, more tongue-shaped, and capable of great extension. It is used for burrowing in the sand or mud of the bottom or for crawling over vegetation or debris on the bottom. Pisidium has been collected from algae far above the bottom, associated with Amnicola and Gyraulus.

In 1916, Utterback (Naiades of Missouri, p. 104) included *Anodonta imbecillis* in the genus Lastena under the Rafinesquian name of *Lastena ohioensis*. Ortmann in 1919 (Mem. Carnegie Mus., VIII(p. 162) and Ortmann and Walker, in 1922 (Occ. Papers, Mus. Zool., Univ. Mich. p. 37), have shown that this name cannot be used for the species, and genus, the name Lastena having been correctly diagnosed and a type fixed by Simpson in 1900 (Proc. U. S. Nat. Mus., XXII, p. 654).

As indicated by Utterback, however, the species *Anodonta imbecillis* differs in several particulars from the other members of the genus Anodonta and it should be recognized as a distinct group of the Anodontinae. The shape of the umbones is quite different, no Anodonta having such flattened beaks. The animal is hermaphroditic and there is no parasitic stage in the development of the glochidium, the process taking place in the marsupium and the young mussel discharged when ready to begin independent life. These characters differentiate *imbecillis* from all other Anodonta at present known. I would, therefore, designate the group as Genus Utterbachia Nov., with *Anodonta imbecillis* as the type.

It is probable that when the various types of shell referred to this genus are critically examined from all parts of its range there will be found differences of specific or varietal importance. Its present known range is from southern Michigan and Wisconsin south to Mexico, east to western New York and west to Kansas and Oklohama. Typically, *imbecillis* is a river form being particularly abundant in small streams where there is a muddy bottom, where it is usually buried from sight.

Utterbackia imbecillis fusca Var. Nov.

Shell differing from typical *imbecillis* in being smaller, more cylindrical, shorter in relation to height, valve less swollen in the center of the disc, and color shades of brown with rarely yellowish rays on an olive background.

L. 48; H. 25; D. 14 mm. Holotype. Univ. Wis. Coll., 927a.

L. 43; H. 21; D. 11 mm. Paratype. Univ. Wis. Coll., 927b.

Type locality: Sturgeon Bay, Door Co., Wis. Types Univ. Wis., 927a-c.

This variety of *imbecillis* occurs on the open shore of Sturgeon Bay below the city. The bottom in this region is of sandy-clay, more or less marly, and with some Chara. It appears to be a dwarfed form of *imbecillis* produced, probably, by its habitat in a turbulent bay, certainly a markedly different environment from the quiet reaches of a small, mud-bottomed stream.

Anodonta henryana Lea, described from Matamoras and Tamaulipas, Mexico, is a member of the genus Utterbackia and probably a distinct species. It is in the Hinkley collection of the University from San Rafael, Texas. A form of *imbecillis* from Alabama may be a variety, but not enough material is at hand to determine this question.

Carunculina parva cahni Nov. Var.

Shell differing from typical *parva* in being larger, more inflated, with heavier hinge teeth. It is well rounded at both ends and there is not the distinct difference due to sex shown in *parva*. The beak sculpture is very heavy.

L. 45.5; H. 25.5; D. 25.0 mm. Type. (U. I. Z17341).

L. 41.0; H. 24.0; D. 22.0 Paratype. (U. I., Z17342).

Type locality: Neosha mill pond, Dodge Co., Wis. Types in Univ. Ill Mus. Nat. Hist., Z17341, Z17342. Also collected in Lake Koshkonong, Jefferson Co., Wis.

This form of *parva* is so distinct from the usual small, more or less compressed form of the species, as found in Wisconsin and Illinois, that it should be designated as a variety. Typical *parva* has a width index of 40-50% while *cahni* has an index of 50-55%. It appears to be a pond or lake form, typical *parva* being a river form, and the distinction may be

largely one of ecology. The specimens were collected by Dr. Alvin R. Cahn, of the Department of Zoology, University of Illinois, to whom the variety is dedicated.

Lampsilis siliquoidea pepinensis Var. Nov.

Shell differing from typical *siliquoidea* in being comparatively shorter and higher, of much greater diameter with a more marked posterior slope, a thicker, heavier shell and more massive pseudocardinal teeth. The surface is usually marked with bright green rays with marked intensity.

L. 94; H. 58; D. 39 mm. Male. Paratype.

L. 77; H. 52; D. 48 mm. Female. Holotype.

L. 87; H. 52; D. 38 mm. Male. Holotype.

Type locality: Lake Pepin, near Lake City, Minn. Collected by Mr. Geo. Wagner. Types in Univ. Wis., Coll., 354, 355, 361.

The *siliquoidea* from Lake Pepin are peculiar in having the valves of the shell very thick and heavy and in being greatly inflated, the female often being almost globular in extreme forms. This form has long been known among mussel fishermen as the "Lake Pepin mucket" and it seems quite appropriate that a scientific name should be given to so marked a variety. It, like many other of the naiades, is a response to lake conditions acting on a river species. The form appears to ascend the St. Croix River as far as Osceola above which the form appears to again resume the *siliquoidea* condition. The material examined, which has been quite ample, shows little variation from the form as indicated in the above diagnosis.

The American Midland Naturalist

PUBLISHED BI-MONTHLY BY THE UNIVERSITY OF NOTRE DAME,
NOTRE DAME, INDIANA

VOL. X. MARCH-MAY, 1927. NOS. 8 and 9.

SOME SPECIES OF VIBURNUM

BENJAMIN FRANKLIN BUSH

After reading the admirable paper of Blake's on some species of *Viburnum*[1], it would seem that all the collector had to do was to collect his specimens and refer them to one or the other of the species he recognizes therein. But a careful and painstaking study of the species found in the middle United States has convinced me that Blake did not fully account for all the forms that occur in this part of the country, at least two of which had been referred to one of the principal species treated by him, and which are readily distinguished.

Perhaps the most important part of Blake's paper is the showing that *V. affine hypomalacum* is the plant that has been passing for *V. pubescens* with all authors, and that the species Britton described as *V. venosum* is really the *V. pubescens* of Pursh. However, there were collections from Pennsylvania, Ohio, Indiana and Kentucky, that Blake seems to have entirely overlooked, and these collections show two quite distinct forms, so much distinct from the *V. venosum* Britton, of the eastern States, that I placed both of them with *V. scabrellum* Chapman, of the Southern States and let them rest there until the past few months.

---

1 Blake, Some Species of *Viburnum*, Rhodora *20:* 11, 1918. Britton in the Manual of 1905, says of *V. molle* Michx., "Kentucky, Missouri and Iowa." This species undoubtedly occurs in Kentucky, but I doubt very much if it has ever been found in Iowa. Robinson and Fernald in the Manual in 1907, say of *V. molle*, "Kentucky (and probably Ohio) Missouri and Iowa." I have seen no specimens from so far east as Ohio, and the Iowa citation is certainly wrong.

Britton and Brown in the Illustrated Flora in 1913 merely follow Britton's Manual in citing Kentucky, Missouri and Iowa for this species.

In a list of the native shrubs of Iowa,[2] Pammel cites the Robinson and Fernald Manual as authority for including *V. molle* in his list, and adds that it occurs in Southern Iowa. He says of this species "leaves narrower than those of the preceding species (*V. pubescens*, i.e. *V. affine hypomalacum*), with slender petioles." This agrees quite well with *V. affine*, but does not describe *V. molle* at all, which has very wide round leaves.

Blake in this same paper,[3] says in a footnote of *V. molle*, "the name *Viburnum pubescens petiolum* (sic) Fitzpatrick (T. J. & M. M. F. L.) Proc. Iowa Acad. *7:* 198, 1900, refers very clearly to *V. molle* Michx. (*V. Demetrionis* Deane and Robinson)." I have Fitzpatrick's description of *V. pubescens petiolum* before me as I write this, and also his type material, which is precisely *V. affine* Bush, and the description also indicates this species. Blake might have been misled by the citation in the Robinson and Fernald Manual to assume that *V. molle* Michx., really did occur in Iowa. I am informed by Fitzpatrick that his Ms. name for this variety was *petiolatum*, and that one of his pupils changed this to *petiolum*, thinking that the word *petiolatum* was not proper. I have seen specimens in the Deam Herbarium, and some in the Herbarium of the Iowa State College, at Ames, Iowa, collected by Fitzpatrick in 1898 and 1899, that are named *V. pubescens petiolatum*. Blake's reference of *V. molle* to Iowa is clearly shown to be erroneous.[4]

---

2 *Pammel*, Native shrubs of Iowa, Proc. Iowa State Hort. Soc. 49, 35, 1915.

3 Blake, l. c. 13.

4 Two names that have been in common use for the cranberry-tree, *Viburnum americanum* Miller, 1768, *V. Opulus americanum* (Miller) Aiton, 1789, have been shown by Blake to refer to two very different plants, the *V. americanum* Miller, Gard Dict. 1768, which was based in *Hydrangea arborescens* L. and the *V. Opulus americanum* Aiton, the plant which Britton and Brown in the Ilustrated Flora in 1913, described as *V. Opulus*. It is quite apparent that Aiton intended

In the following account of some species of *Viburnum*, I recognize eleven species and four varieties, which is some five or six more than are described in the Manuals and Floras, and nine more than are described by Blake in his paper. In order that this paper may be as complete as possible, I have cited all the specimens examined of the species discussed, from Indiana, Illinois, Missouri and Iowa, that the fullest benefit may be derived from my studies, and that other students of their species may know precisely what my understanding of each species and variety was.

For the convenience of those who wish to name specimens of VIBURNUM of the species here considered, I offer the following:

KEY TO THE SPECIES

A. Outer flowers of the cymes large, radiant; drupes red. B.
A. None of the flowers radiant. C.
B. Leaves doubly serrate, pinnately veined.

1. VIBURNUM ALNIFOLIUM.

B. Leaves 3-lobed, palmately veined.

2. VIBURNUM TRILOBUM.

C. Leaves palmately veined, 3-lobed. D.
C. Leaves pinnately veined, coarsely serrate or dentate, the primary veins more or less prominent on the under surfaces of the leaves. E.
D. Cymes very small, 12-25 mm. broad, the rays short; drupes red.

3. VIBURNUM PAUCIFLORUM.

D. Cymes larger, 4-7 cm. broad, the rays slender; drupes black.

---

to take up Miller's species *americanum* and reduce it to a variety under the European *V. Opulus* L., even if he did not mention Miller as the author of the name *americanum*, and this being the case the next available name for this species would be *V. trilobum* Marshall, 1785, and I do not understand why Blake did not use this name in his paper. I am constrained to speak of this now for the reason that I have here before me a book entitled Standardized Plant Names, bearing date of 1923, prepared by a sub-committee, in which the name *Viburnum americanum* is given for this same species, when in fact that name rests on the *Hydrangea arborescens* L.

4. VIBURNUM ACERIFOLIUM.

E. Petioles very short, much less than 5 cm. long; stipules very pronounced; leaves densely pubescent, or almost velvety, beneath; cymes mostly 3-5 cm. broad; drupes oblong-oval, black, about 10 mm. long, edible; eastern.

6A. VIBURNUM AFFINE HYPOMALACUM.

E. Petioles longer, up to 5 cm. long. F.

F. Leaves glabrous, or merely with tufts of hairs in the axils of the primary veins beneath; stipules lacking; eastern and northern.

7. VIBURNUM DENTATUM.

F. Leaves pubescent beneath, sometimes densely so. G.

G. Drupes oblong, about 10-15 mm. long; stipules present. H.

G. Drupes globose-ovoid, about 8 mm. long, inedible; cymes mostly 5-10 cm. broad. J.

H. Leaves ovate, ovate-oblong, or ovate-lanceolate; cymes mostly 3-5 cm. broad; drupes about 10 mm. long; western and northern.

6. VIBURNUM AFFINE.

H. Leaves round-ovate or nearly orbicular, cordate at the base, very soft; cymes 5-10 cm. broad; drupes about 15 mm. long; southern. I.

I. Leaves softly pubescent all over the under surfaces.

8. VIBURNUM MOLLE.

I. Leaves glabrous or nearly so between the primary veins beneath; primary veins pubescent.

9A. VIBURNUM MOLLE FORMA LEIOPHYLLUM.

J. Twigs, petioles, peduncles and rays of the cymes more or less fascicled-pubescent or fascicled-tomentose, scarcely or not at all scabrous. K.

J. Twigs, petioles, peduncles and rays of the cymes more or less scurfy and scabrous; stipules lacking; veins on the lower surfaces of the leaves not very prominent; southern. M.

K. Lower surfaces of leaves very veiny, the primary veins prominent, the cross-veins conspicuous, roughish-pubescent or fascicled-pubescent beneath; stipules lacking; eastern and northern.

5. VIBURNUM PUBESCENS.

K. Leaves not very veiny, the primary veins on the under surface of the leaves inconspicuous or scarcely noticeable. L.

L. Lower surfaces of the leaves densely soft-pubescent or nearly velvety; stipules present.

9. VIBURNUM DEAMII.

L. Lower surface of the leaves merely pubescent along the primary veins; stipules present, or sometimes rare or lacking. M.

M. Young branchlets pubescent, rarely a few petioles with stipules.

9A. VIBURNUM DEAMII CANBYI.

M. Young branchlets glabrous; most of the petioles bearing stipules.

9B. VIBURNUM DEAMII INDIANENSE.

N. Whole plant very scurfy-scaly; leaves larger and thicker, densely fascicular-pubescent beneath; cymes larger, 7-14 cm. wide, densely fascicular-pubescent; drupes larger.

10. VIBURNUM SCABRELLUM.

N. Plant nearly glabrous, or but little scurfy-scaly; leaves smaller and thinner, glabrous above and soon glabrous beneath; cymes much smaller, 4-6 cm. wide, soon becoming glabrate; drupes much smaller.

11. VIBURNUM ASHEI.

1. VIBURNUM ALNIFOLIUM Marsh. Arb. Am. 102. 1785.

V. lantanoides Michx. Fl. Bor. Am. *1:* 179, 1803.

N. B. to N. Car., Ont. Tenn., and Mich., according to Britton and Brown in Ill. Flora, 1913.

N. B. to Ont., Mich. to Pa., and in the mountains of N. Car., according to Robinson and Fernald in Manual, 1908.

N. B. to Mich. and N. Car., according to Small in Flora, 1913, specimens of this northern species have been examined by me, amongst the several hundred specimens of Viburnum examined.

2. VIBURNUM TRILOBUM Marsh. Arb. Am. 162. 1785.

V. americanum of most authors, not *V. americanum* Mil-

ler, 1768, which is said on authority of Blake to be nothing but *Hydrangea arborescens* L.

V. Opulus americanum (Mill.) Ait. Hort. Kew. *1:* 373. 1789, obviously based on *V. americanum* Mill., which is only *Hydrangea arborescens* L.

V. Opulus americanum of many authors, not *V. Opulus* L., 1753, which is an European species.

Nfd. to Que. and B. Col. south to N. J., Pa., Mich., Wis., and Ia., according to Robinson and Fernald in Manual, 1908.

Nfd. to B. Col., N. J., Mich., Ia., S. Dak., and Ore., according to Britton and Brown in Ill. Flora, 1913.

SPECIMENS EXAMINED:

INDIANA

Clark Station, *Gamon,* August 20, 1898, D. Herb.; Clear Lake, *Deam* 15857, June 6, 1915, D. Herb.; Lake George, *Burrill,* July 13, 1880; Lake Oliver, *Deam* 15857, D. Herb.; Ontario, *Deam* 15020, August 30, 1914; Wells County, *Deam,* May 13, 1903.

ILLINOIS

Mount Carmel, *Schneck,* June 1865, U. of Ill. Herb.; Peoria, *Brendel,* date not given, U. of Ill. Herb.

IOWA

Fayette, *Fink,* September, 1893; Pierce's Bridge, *Mrs. Tuttle* 10, October, 1913, P. Herb.; Postville, *Pammel* and *Schultz,* June 15, 1913, P. Herb.

3. VIBURNUM PAUCIFLORUM Pylaie; T. & G. Fl. N. A. *2:* 17 1841.

V. Opulus eradiatum Oakes, Hovey's Mag. *7:* 183. 1841.

Nfd. to Alaska, Pa., Col. and Wash., according to Britton and Brown in Ill. Flora. 1913.

Nfd. and Lab. to Alaska, south to the mountains of Cape Breton Island, northern New England, Allegheny County, Pa., northern Mich., Minn., Col., and Washington, according to Robinson and Fernald in Manual, 1908.

No specimens of this high northern species have been seen by me amongst the large number of specimens examined.

4. VIBURNUM ACERIFLORUM L. Sp. Pl. 268. 1753

N. B. to Ga., Ala., Ont., Mich., and Minn., according to Britton and Brown in Ill. Flora, 1913.

N. B. to Ont., Minn., and Ga., according to Small in Flora, 1913. N. B. to Minn., Ky., and Ga., according to Robinson and Fernald in Manual, 1908.

A species of the northeastern States, extending as far southwest as Indiana and Illinois.

INDIANA

Adams Lake, *Deam* 14837, August 27, 1914, D. Herb.; Brazil, *Deam* 38998, July 7, 1923, D. Herb.; Borden, *Deam* 40024, October 11, 1923, D. Herb.; Buffalo, *Deam* 29514, August 24, 1919, D. Herb.; Bloomington, *Deam* 23595, June 9, 1917, D. Herb.; Bloomington, *Deam* 38959, July 4, 1923, D. Herb.; Charleston, *Deam* 17996, July 27, 1919, D. Herb.; Cincinnati, *Deam* 26100, August 10, 1918, D. Herb.; Clear Lake, *Deam* 26408, September 13, 1918, D. Herb.; Clear Lake, *Deam*, June 12, 1904, D. Herb.; Cataract, *Deam* 10295, October 15, 1911, D. Herb.; Delaware, *Deam* 36990, July 22, 1922, D. Herb.; Dune Park, *McDonald*, July 4, 1902, U. of Ill. Herb.; Elizabeth, *Deam* 16383, June 24, 1915, D. Herb.; Fort Wayne, *Deam* 34536, July 31, 1921, D. Herb.; Gilead, *Deam* 31908, July 16, 1920, D. Herb.; Grayford. *Deam* 38593, May 30, 1923, D. Herb.; Hartford City, *Deam* 32058, August 5, 1920, D. Herb.; Helmsburg, *Deam* 6567, June 5, 1910, D. Herb.; Helmsburg, *Deam* 11160, June 1912, D. Herb.; Jackson Township, Wells County, *Deam*, June 1, 1902, D. Herb.; Kendallville, *Deam* 3079, May 31, 1908, D. Herb.; Kent, *Deam* 35282, October 10, 1921, D. Herb.; Knox, *Deam* 19969,June 1, 1916, D. Herb.; Lafayette, *Dorner*, June 8, 1901, D. Herb.; Miller, *Chase* 105, June 14, 1897, U. of Ill. Herb.; Miller, *Chase* 517, August 23, 1897, U. of Ill. Herb.; Miller, *Chase* 1258, October 5, 1899, U. of Ill. Herb.; Miller, *Chase* 1775, May 30, 1902, U. of Ill. Herb.; Mitchell, *Deam* 1725, July 12, 1915, D. Herb.; Mitchell, *Deam* 18501, September 2, 1915, D. Herb.; Morgantown, *Deam* 877, May 23, 1906, D. Herb.; Michigan City, *Deam* 5225, August 16, 1908, D. Herb.; Morgantown, *Deam* 860, May 22, 1906, D. Herb.;

Milford, *Deam* 34474, July 3, 1921, D. Herb.; Metamora, *Deam* 32886, September 17, 1920, D. Herb.; Middlebury, *Deam* 10991, June 4, 1912, D. Herb.; Mudlavia, *Deam* 10008, September 11, 1911, D. Herb.; Mount Etna, *Deam* 31041, June 8, 1920, D. Herb.; Brown County, *John S. Wright*, July 14, 1892, U. of Ill. Herb.; Clark County, *Deam* 38613, June 1, 1923, D. Herb.; Clark County, *Deam* 6466, May 21, 1910, D. Herb.; Adams County, *Deam* 32598, August 31, 1920, D. Herb.; Hancock County, *Deam* 12424, September 19, 1912, D. Herb.; Jennings County, *Deam* 9147, July 9, 1911, D. Herb.; Decatur County, *Deam* 40073, October 15, 1923, D. Herb.; Orange, *Deam* 34048, May 16, 1921, D. Herb.; Pine, *Deam* 2354, July 28, 1907, D. Herb.; Plymouth, *Deam* 15098, Aug. 31, 1914, D. Herb.; Paoli, *Deam* 35631, May 14, 1922, D. Herb.; Pulaski, *Deam* 38849, June 9, 1923, D. Herb.; Round Lake, *Deam* 14545, August 23, 1914, D. Herb.; Russellville, *Grimes* 7736, March 5, 1911, U. of Ill. Herb.; Shoals, *Deam* 12869, May 20, 1913, D. Herb.; Shoals, *Deam* 17204, July 11, 1915, D. Herb.; Saint Joe, *Deam* 32551, August 30, 1920, D. Herb.; South Bend, *Deam* 14207, May 29, 1914, D. Herb.; Salem, *Deam* 20579, June 29, 1916, D. Herb.; Sugar Creek, *Deam* 7248, August 21, 1910, D. Herb.; Terre Haute, *Deam* 30862, September 17, 1920, D. Herb.; Montgomery County, *Deam* 9264, July 23, 1911, D. Herb.; Vallonia, *Deam* 17428, July 15, 1915, D. Herb.; Versailles, *Deam* 16117, June 18, 1915, D. Herb.; Van Buren, *Deam*, June 16, 1907, D. Herb.; Van Buren, *Deam*, July 7, 1907, D. Herb.; Cannelton, *Deam* 33210, October 1, 1920, D. Herb.

ILLINOIS

Calumet Heights, *Gates*, May 30, 1906, U. of Ill. Herb.; Calumet Heights, *Gates*, August 16, 1906, U. of Ill. Herb.; Elgin, *Vasey*, date not given, U. of Ill. Herb.; Ravinia, *Gates* 1699.1, June 22, 1907, U. of Ill. Herb.; River Grove, *Chase* 282, July 14, 1897, U. of Ill. Herb.; Thornton, *Chase* 1080, June 2, 1899, U. of Ill. Herb.

5. VIBURNUM PUBESCENS (Aiton) Pursh, Fl. Am. Sept. *1:* 202. 1814.

V. dentatum pubescens Ait. Hort. Kew. *1:* 372. 1789.

V. venosum Britton, Man ed. 1, 871, 1901.

V. molle of authors in part, not *V. molle* Michx. 1803.

A species of New England, as far south and west as Delaware and eastern Pennsylvania. Martha's Vineyard and Nantucket to Pa. and Del., according to Robinson and Fernald in Manual, 1909.

Eastern Mass. to N. J., Pa. and Va., according to Britton and Brown in Ill. Flora, 1913, the Virginia citation evidently referring to *V. Deamii Canbyi,* which is here included in *V. venosum.*

Eastern Mass. to Pa., and Del., and reappearing in a peculiar form in South Carolina, according to Rehder,[5] l. c. but the South Carolina specimens must belong to some other species, as *V. pubescens* does not get so far south as that State.

No specimens of this northern species have been seen by me amongst the many specimens examined.

6. VIBURNUM AFFINE Bush, ex Rehder, in Sargent, Trees and Shrubs *1:* 135. 1903.

V. pubescens affine (Bush) Rehder, Mitt. Deutsch. Dendrol. 263. 1913.

V. pubescens authors, in small part, not *V. pubescens* Pursh, 1814.

V. pubescens petiolum Fitzpatrick, Proc. Iowa Acad. Sci. *7:* 198. 1900, type from Rock Creek, Jefferson County, Iowa, *Fitzpatric,* Fitzpatrick,[6] l. c., co-type from Jackson County, Iowa, *Fitzpatrick,* Fitzpatrick,[7] l. c., which he says was referred to *V. dentatum,* along with many other Iowa specimens. Fitzpatrick originally wrote this *petiolatum,* but some one of his pupils changed this to *petiolum,* as being the more proper.

Ontario, Ill., Minn., Ia., Va., and Mo., according to Blake,[8] l. c., but the Virginia reference must be an error, as I have not seen any specimens from anywhere east of Indiana.

---

5 Rehder, l. c. 60.

6 Fitzpatrick, l. c. 199.

7 Fitzpatrick, l. c. 199.

8 Blake, l. c. 13.

SPECIMENS EXAMINED:

ILLINOIS

Calumet Heights, *Gates,* May 30, 1906, U. of Ill. Herb.; Carlinville, *Andrews,* June 1, 1891, U. of Ill. Herb.; Fountaindale, *Bebb,* month not given, 1867, U. of Ill. Herb.; Glenwood, *Chase* 54, June 9, 1897, U. of Ill. Herb.; Peoria, *Brendel,* June, year not given, U. of Ill. Herb.; Peoria, *Brendel,* date not given, U. of Ill. Herb.; Peoria, *McDonald,* May, 1884, U. of Ill. Herb.

INDIANA

Bluffton, *Deam,* May 26, 1905, D. Herb.; Bluffton, *Deam,* May 26, 1905, D. Herb.; Broad Ripple, *Deam,* June 3, 1897, D. Herb.; Clear Lake, *Deam,* June 12, 1904, D. Herb.; Garrett, *Deam* 3142, June 30, 1908, D. Herb.; Long Lake, *Kienbolz,* May 26, 1918, U. of Ill. Herb.; Michigan City, *Deam,* September 13, 1919, D. Herb.; Miller's, *Deam* 9569, August 14, 1911, D. Herb.; Miller's, *Deam* 32331, August 24, 1920, D. Herb.; Waverly Beach, *Deam* 19995, date not given, D. Herb.

IOWA

Allamakee County, *Shultz,* August, 1914, P. Herb.; Ames, *Ellis* 25, July 20, 1914, P. Herb.; Ames, *Pammel,* May 21, 1901, P. Herb.; Ames, *Sinires,* no month given, 1890, P. Herb.; Boone County, *Pammel, Buchanan* and *King* 3965, July 25, 1903, P. Herb.; Boone County, *King,* photograph, no date, P. Herb.; Boone County, *Pammel,* May 1898, P. Herb.; Boone County, *Pammel,* no month given, 1898, P. Herb.; Boone County, *Pammel,* May 21, 1921, P. Herb.; Boone County, *Pammel,* August, 1898, P. Herb.; Backbone Park, *Pammel,* August 23, 1920, P. Herb.; Cherokee, *Pammel,* September 5, 1920, P. Herb.; Decatur County, *Anderson,* May 17, 1902, P. Herb.; Decorah, *Holway,* May 21, 1881, P. Herb.; Delaware County, *Bode,* August, 1919, P. Herb.; Dubuque County, *Pammel* and *Frank,* June 18, 1922, *P. Herb.;* Clayton County, *Pammel* 12, June 10, 1917, P. Herb.; Estherville, *Pammel,* September 17, 1920, P. Herb.; Estherville, *Wolden* 405, May 29, 1922, P. Herb.; Fayette, collector not given, May 4, 1894, P. Herb.; Iron Springs, collector not given, July 25, 1917, P.

Herb.; Johnson County, *Fitzpatrick*, May 27, 1900, labeled *V. dentatum*, P. Herb.; Johnson County, *Fitzpatrick*, July 31, 1898, labeled *V. petiolatum*, P. Herb.; Lake Mills, *Pammel*, August 22, 1918, P. Herb.; Lamont, *Bode*, August 13, 1919, P. Herb.; Linn Creek, *Pammel*, July 28, 1918, P. Herb.; Mason City, *Pammel*, September 4, 1902, P. Herb.; Moingona, *Pammel* and *Combs*, May 22, 1897, P. Herb.; no locality given, *Pammel* and *Miller*, no month given, 1911, P. Herb.; North McGregor, *Pammel*, July 7, 1891, P. Herb.

MISSOURI

Cole Camp Creek, *Trelease* 3, May 19, 1904, A. A. Herb.; Dumas, *Bush* 5893, May 8, 1909, A. A. Herb.; Dumas, *Bush* 9494, August 29, 1921, A. A. Herb.; Dumas, *Palmer* 21890, September 7, 1922, A. A. Herb.; Eagle Rock, *Bush* 189, June 21, 1897, A. A. Herb.; Galena, *Palmer* 24873, September 24, 1925, A. A. Herb.; Monteer, *Bush* 2815, May 11, 1905, A. A. Herb.; Monteer, *Bush* 3395, September 23, 1905, A. A. Herb.; Monteer, *Bush* 3603, October 8, 1905, A. A. Herb.; Monteer, *Bush* 4746, May 27, 1907, A. A. Herb.; Monteer, *Bush*, October 6, 1920, A. A. Herb.; Monteer, *Palmer* 19360, October 6, 1920, A. A. Herb.; Swan, *Bush* 41, June 5, 1899, A. A. Herb.; Swan, *Bush* 776, October 10, 1899, A. A. Herb.; Swan, *Bush* 4575, May 20, 1907, A. A. Herb.

6A. VIBURNUM AFFINE HYPOMALACUM Blake, Rhodora *20:* 14, 1918.

V. pubescens, of large part, of most authors, not *V. pubescens*, Pursh, 1814.

V. pubescens Fitzpatrick, Proc. Iowa Acad. Sci. *7:* 198, 1900.

V. pubescens Pammel, Proc. Iowa State Hort. Soc. 44, 1915.

Vermont to Ontario, Manitoba, Saskatchewan, south to Indiana, Illinois, Missouri and Iowa.

This northern form has been commonly named *V. pubescens* by authors, but it is clearly distinct from that species.

Vermont and Ontario to Georgia, Michigan and Manitoba, according to Blake l. c. 14, 1918, but I have seen no specimens from any of the southern States.

SPECIMENS EXAMINED:

INDIANA

Adams County, *Deam* 32599, August 31, 1920, D. Herb.; Cedar Creek, *Deam*, 15825, May 31, 1915, D. Herb.; Columbia City, *Deam* 36824, July 10, 1922, D. Herb.; Elkhart, *Deam* 32445, August 27, 1920, D. Herb.; High Lake, *Deam* 32651, June 18, 1917, D. Herb.; Michigan City, *Deam* 38802, June 2, 1923, D. Herb.; Michigan City, *Deam* 36402, June 10, 1922, D. Herb.; Mongo, *Deam* 32474, August 28, 1920, D. Herb.; North Manchester, *Deam* 39554, August 10, 1923, D. Herb.

ILLINOIS

Maywood, *Chase* 21, June 2, 1897, U. of Ill. Herb.; Ringwood, *Vasey*, date not given, U. of Ill. Herb.

MISSOURI

Dumas, *Bush*, September 7, 1922, A. A. Herb.; Dumas, *Palmer* 21845, September 7, 1922, A. A. Herb.

IOWA

Ames, *Carver*, month not given, 1895, P. Herb.; Ames, *Pammel* and *Combs*, month not given, 1897, P. Herb.; Decatur County, *Fitzpatrick*, May 29, 1898, laballed *V. pubescens*, P. Herb.; Decatur County, *Fitzpatrick*, May 29, 1898, P. Herb.; Fort Dodge, *Horton*, May 1912, P. Herb.; Lake Okoboji, *Pammel* 467, July 25, 1914, P. Herb.

7. VIBURNUM DENTATUM L. Sp. Pl. 268. 1753.

New Brunswick and Ontario south to Georgia and western New York, Michigan and Minnesota, according to Britton and Brown in Ill. Flora, 1913, but I have seen no specimens from the southern States.

New Brunswick to northern Georgia, west to western New York and southern Ontario, Robinson and Fernald in Manual, 1908.

New Brunswick to Ontario, Minnesota and Florida, Small in Flora, 1913, but the Florida citation is certainly erroneous, as this species does not reach Florida or any of the southern States.

A species of the northeastern States, extending to Indiana, western Illinois and Iowa.

INDIANA

Henryville, *Deam* 38606, June 1, 1923, D. Herb.; Henryville, *Deam* 38606, October 13, 1923, D. Herb.

ILLINOIS

Olney, *Ridgway*, 1926, September 24, 1922, R. Herb.; Olney, *Ridgway* 2388, May 20, 1925, R. Herb.

IOWA

Decatur County, *Anderson*, date not given, P. Herb.

8. VIBURNUM MOLLE, Michx. Fl. Bor. Am. *1*:180. 1803.

V. Demetrionis Deam and Robinson, Bot Gaz. *22:* 167. 1896.

Kentucky, southern Indiana and southern Missouri.

Kentucky, Missouri and Iowa according to Britton in Manual, 1905, but the Iowa reference must be based on some other species, as no specimens are known of this species from Iowa.

Kentucky (and probably Ohio) Missouri and Iowa, Robinson and Fernald in Manual, 1908, but the Iowa citation must apply to *V. affine*, as no specimens are known of *V. molle* from Iowa, and all evidence points to *V. affine* as the basis of these references to Iowa.

Kentucky, Missouri and Iowa, Britton and Brown in Ill. Flora, 1913, being merely a repetition of the range given by the Britton Manual.

Iowa, according to Pammel in Trans. Iowa State Hort. Soc. *49:* 44. 1915, but Pammel's specimens were certainly *V. affine*, for his description "leaves narrower than the preceding species (*V. pubescens*, i. e. *V. affine hypomalacum*) with slender petioles," applies clearly to *V. affine* and not to *V. molle*, which has broad, round, soft leaves.

Iowa, according to Blake, l. c. 13, referring Fitzpatrick's *V. pubescens petiolum* to this species, but Fitzpatrick's variety

is clearly *V. affine* Bush, as shown by both his description and specimens.

Cole Camp Creek and Galena, Missouri, Rehder, l. c. 57, 1904. Boone and Carroll Counties, Indiana, Rehder, l. c. 57. 1904.

SPECIMENS EXAMINED:

INDIANA

Idaville, *Deam* 17764, July 22, 1915,[9] D. Herb.; Idaville, *Deam* 58344, September 17, 1923, D. Herb.; Idaville, *Deam* 38344, September 17, 1923, D. Herb.; Versailles, *Deam* 38580, May 30, 1923, D. Herb.; Versailles, *Deam* 40064, October 14, 1923, D. Herb.

MISSOURI

Christian County, *Bush* 3480, September 28, 1905,[10] A. A. Herb.; Christian County *Bush* 4625, May 21, 1907, A. A. Herb.; Cole Camp Creek, *Demetrio*, May 27, 1896, TYPE of *V. Demetrionis*, A. A. Herb.; Cole Camp Creek, *Trelease* 384, July 17, 1897, A. A. Herb.; Galena, *Palmer* 14361, September 18, 1918, A. A. Herb.; Galena, *Palmer* 23872, September 24, 1923, A. A. Herb.

---

9 Of this collection, Deam says "this is the outlaw specimen, note shape of fruit," alluding to its dissimilarity to the fruit of *V. Deamii* and *V. Deamii indianense*, which were at that time included in *V. molle* by him, as differing from *V. pubescens*. The piece of bark mounted on this sheet is not from the same plant as the leafing specimen, as it is nearly black, and not exfoliating, while *molle* has yellowish-brown loose exfoliating bark.

10 This species was found on the rocky banks of Billiu Creek, just north of the Taney County line, in Christian County, about five miles North of Swan, Taney County, on Billiu Creek, where *V. molle leiophyllum* is fairly common. It is therefore probable that *V. molle* also occurs in Taney County, and as the Taney County and Christian County localities are only about 25 miles east of Galena, Stone County, it may be said that they are the same general region as the Benton County locality.

8A. VIBURNAM MOLLE FORMA LEIOPHYLLUM Rehder, Journ. Arn. Arboretum *5:* 57. 1924.

South central Missouri, apparently very local.

SPECIMENS EXAMINED:

MISSOURI

Cole Camp Creek, *Trelease* 4, May 19, 1904, U. of Ill. Herb.; Cole Camp Creek, collector not given, according to Rehder, l. c., probably based on Trelease's collection; Galena, *Palmer* 17226, April 17, 1920, A. A. Herb.; Galena, *Palmer* 22816, May 23, 1923, A. A. Herb.; Galena, *Palmer* 23872a, September 24, 1923, A. A. Herb.; Galena, *Palmer* 4671, October 15, 1913, A. A. Herb.; Galena, *Palmer* 5671, May 20, 1914, A. A. Herb.; Noel, *Bush* 5531, April 25, 1909, A. A. Herb.; Noel, *Bush* 5763, May 27, 1909, A. A. Herb.; Swan, *Bush*,[11] 798, October 9, 1899, A. A. Herb.; Swan, *Sargent*,

9. VIBURNUM DEAMII (Rehder) n. sp.

V. pubescens Deamii Rehder, Journ, Arnold Arboretum *5:* 58. 1924. A species apparently confined to the Ohio River Basin.

SPECIMENS EXAMINED:

INDIANA

Bloomington, *Deam* 35813, May 20, 1922, D Herb.; Chestnut Ridge, *Deam* 38619, June 18, 1923, D. Herb.; Fairview, *Deam* 40040, October 13, 1923, D. Herb.; Helmsburg, *Deam* 11149, June 16, 1912, D. Herb.; Helmsburg, *Deam* 38950, July 4, 1923, D. Herb.; Helmsburg, *Deam* 11148, June 16, 1912, D. Herb.; Helmsburg, *Deam*, 12217, August 25, 1912, D. Herb.; Helmsburg, *Deam* 1147, June 16, 1912, D. Herb.; October 9, 1899, A. A. Herb.; Swan, *Bush* 3449, September 26, 1905, A. A. Herb.; Swan, *Bush* 4586, May 20, 1907, A. A. Herb.

---

11 The specific form, *V. mol.e*, was found along the rocky banks of Billiu Creek, just north of the Taney County line, in Christian County, about five miles north of the locality at Swan, Missouri, and along the same creek where *V. molle leiophyllum* was found.

Henryville, *Deam* 7580, September 24, 1910, D. Herb.; Henryville, *Deam* 12251, August 30, 1912, D. Herb.; Lake, *Deam* 37505, August 10, 1922, D. Herb.; Lake, *Deam* 39951, October 2, 1923, D. Herb.; Lake, *Deam* 39952, October 2, 1923, D. Herb.; Madison, *Deam* 18848, September 9, 1915, D. Herb.; San Jacinto, *Deam* 38595, May 30, 1923, D. Herb.; San Jacinto, *Deam* 38598, May 30, 1923, D. Herb.; San Jacinto, *Deam* 38878, June 16, 1923, D. Herb.; San Jacinto, *Deam* 38107, September 27, 1922, D. Herb.; Saint Meinard, *Deam* 16541, June 28, 1915, D. Herb.; Scipio, *Deam* 12030, August 13, 1912, D. Herb.

9A. VIBURNUM DEAMII CANBYI (Rehder) n. comb.

V. venosum Canbyi Rehder, Rhodora *6:* 60. 1904.

V. pubescens Canbyi (Rehder) Blake, Rhodora *18:* 15. 1918.

Eastern Pennsylvania, Delaware and Virginia.

Pennsylvania and Delaware to the mountains of Virginia, according to Robinson and Fernald in Manual, 1908, evidently referring to the collections of Canby and Small as cited below. I have not been able to see any authentic specimens of this variety, but it is said to differ from *V. Deamii* Bush, and the variety *indianense,* in having pubescent young branchlets. To this form Rehder refers a specimen collected at Mt. Hope, Pennsylvania, June 24, 1901, by Heller. This specimen may or may not belong to *var. Canbyi,* but I have seen one of Heller's specimens collected at Mt. Hope, Pennsylvania, dated June 24, 1901, in Deam's collection, and I take this to be a good example of *V. Deamii indianense.* If I am right in this, and this collection of Heller's is really var. *Canbyi,* then the name *indianense* becomes a synonym of *Canbyi.*

SPECIMENS CITED:

DELAWARE

Christiana, *Canby,* August 25, 1902, according to Rehder, l. c. 60; New Castle, *Canby,* July 2, 1902, according to Rehder, l. c. 60; Wilmington, *Canby,* July 2, 1902, according to Rehder, l. c. 60; Wilmington, *Canby,* August 22, 1902, according to Rehder, l. c. 60.

PENNSYLVANIA

Mt. Hope, *Heller*, June 24, 1901, according to Rehder, l. c. 61; Westchester, *Canby*, October 8, 1902, according to Rehder, l. c. 61.

VIRGINIA

Southwest Virginia, *Small*, July 16, 1892, according to Rehder, l. c. 61, probably being the form cited by Britton and Brown in Ill. Flora, and by Robinson and Fernald in Manual, under *V. pubescens.*

9B. VIBERNUM DEAMII INDIANENSE (Rehder) n. comb.

V. pubescens indianense Rehder, Journ. Arnold Arboretum *5:* 59. 1924.

Said by Rehder to differ from *V. Deamii Canbyi*, in having stipules on most of the petioles, by which character it agrees with *V. Deamii.* It may be distinguished from *V. dentatum* by the presence of stipules, larger inflorescence, and larger short ellipsoid fruit, that species not having stipules on the petioles, and has smaller subglobose fruit and dense smaller inflorescence.

SPECIMENS EXAMINED:

PENNSYLVANIA

Mount Hope, *Heller*, June 24, 1901, D. Herb., apparently the same collection cited by Rehder as belonging to *V. Deamii Canbyi*, but certainly is *V. Deamii indianense.*

INDIANA

Borden, *Deam* 40022, October 11, 1923, D. Herb.; Brazil, *Deam* 38986, July 7, 1923, D. Herb.; Brazil, *Deam* 39002, September 19, 1923, D. Herb.; Clear Springs, *Deam*, 19046, September 14, 1915, D. Herb.; Grantsbury, *Deam*, 27761, June 7, 1919, D. Herb.; Hagerstown, *Deam* 38163, September 24, 1922, D. Herb.; Hillsboro, *Deam* 36020, May 24, 1922, D. Herb.; Mitchell, *Deam* 18517, September 2, 1915, TYPE, D. Herb.; Morris, *Deam* 10558, May 19, 1912, D. Herb.; Osgood, *Deam* 38874, June 15, 1923, D. Herb.; Rockport, *Deam* 39971, October 4, 1923, D. Herb.; Russellville, *Grimes* 582,

August 14, 1911, U. of Ill. Herb.; Versailles, *Deam* 16119, June 19, 1915, D. Herb.; Versailles, *Deam* 18838, September 9, 1915, D. Herb.

ILLINOIS

Olney, *Ridgway* 363, August 14, 1919, R. Herb.; Olney, *Ridgway* 1927, September 24, 1922, R. Herb.; Olney, *Ridgway* 1928, September 24, 1922, R. Herb.

10. VIBURNUM SCRABRELLUM (T. & G.) Chapm. Fl. S. States, 172. 1860.

V. dentatum B ? scrabellum T. & G. Fl. N. Am. *2:* 16, 1841.

V. dentatum B semitomentosum Michx. Fl. Bor. Am. *1:* 179. 1903.

V. molle A. Gray, Man. ed. 5, 206. 1867, and authors, not *V. molle* Michx. 1803.

V. molle var. ? *tomentosum* Chapm. Fl. S. States, ed 3, 190. 1897.

V. semitomentosum (Michx.) Rehder, Rhodora *6:* 59. 1904.

This species ranges from North Carolina to Florida, west to Texas, mostly along the coast.

Pennsylvania, according to Blake, l. c. 1918, but evidently referring to one of the other of Canby's or Heller's collections. This species does not get so far north as Pennsylvania or Indiana, and it is probable that Blake saw specimens of *V. Deamii Canbyi*, or *V. Deamii indianense* and took them to be *V. scabrellum*.

Pennsylvania to Florida and Texas, according to Small in Flora, 1913, but evidently referring to the same collections that Blake mentioned.

Rehder states that this species occurs in Kentucky, but no specimens have been seen from so far north as that State.

11. VIBURNUM ASHEI Bush, Am. Mid. Naturalist *9:* July, 1924.

Mississippi and probably in adjoining States along the coast. In foliage this species strongly resembles *V. affine* Bush, but is clearly allied to *V. scabrellum* Chapman, by its

fruit, and indeed it may be an extreme form of that species, although the smaller fruit, smaller inflorescece, smaller and thinner leaves and particularly the glabrous twigs, leaves and cymes, seem sufficient to recognize it as a species.

SPECIMENS EXAMINED:

MISSISSIPPI

Little Obolo-Chitto River, Pearl County, TYPE, *Ashe*, A. Herb.; along the Pascagoula River, George County, *Ashe*, A. Herb.; along the Tallahoma River, Jones County, *Ashe*, A. Herb.; along the Chickasawhay River, near Leakesville, Greene County, *Ashe*, A. Herb.

LIST OF FLOWERING PLANTS AND FERNS IN THE DUNES STATE PARK AND VICINITY, PORTER COUNTY, INDIANA.

MARCUS WARD LYON, JR.,

South Bend, Ind.

In 1922, I made a small collection of the more conspicuous plants in the dunes region of Porter County, chiefly as an outdoor pastime on Sundays and holidays. After the first season I became more interested in the flora of the region so that during the five years that I have frequented it I feel that I have collected a fair representation of the plants of the area. The resulting collection numbers about 2000 specimens, distributed among over 780 different species or named forms. This number scarcely exhausts the flora of the region for during the fifth season it was not unusual to find one or more previously unnoticed forms on the week-ends that I visited it. Although several authors* have dealt with this area to point out the interesting floral characteristics of the Indiana dunes of Lake Michigan, yet no one so far as I am aware has published a list of all the plants, native or introduced, of the dune area of Porter County as a whole. Time has been lacking to search literature for published records of Porter County plants. With a few exceptions noted in the list, the specimens are all in the writer's herbarium and have been collected by him.

The classification and plant names used in this paper are based on those found in Britton and Brown's Illustrated Flora of the Northern United States, Canada and the British Pos-

---

* Cowles, H. C., Physiographic Ecology of Chicago and Vicinity. Bot. Gaz., 31.

Cowles, H. C., Plant Societies of Chicago and Vicinity, Geogr. Soc., Chicago, Bull. 2.

Coulter, Stanley, Catalogue of the Flowering Plants, Ferns and their Allies indigenous to Indiana.

Downing, E. R., A Naturalist in the Great Lakes Region, 1922.

sessions, second edition; in House's Annotated List of the Ferns and Flowering Plants of New York State, 1924; and in Deam's Trees of Indiana and Shrubs of Indiana.

Dr. J. A. Nieuwland has kindly called to my attention a few names apparently perfectly valid for some genera or at least groups of plants to which other names are commonly assigned. After seeing the original publication of the names I have adopted them feeling confident that they will stand as valid under rules of nomenclature as efficient and as open to as little controversy as those employed by zoologists.

Common names have been given for nearly all the species, being based mainly on those in Britton and Brown's Illustrated Flora, although many of these names are extremely artificial and more or less meaningless.

The area under consideration is the northern strip of Porter County from the right of way of the Chicago, South Shore, and South Bend Railway north to the waters of Lake Michigan; from Tamarack Station on the east to the station known as Wilson or Dune Park on the west. It is approximately ten miles in length from east to west and about one or slightly more miles in width from south to north. Most of the collecting has been done in or near the new Dunes State Park.

During the five years that I have visited the region I have been impressed with the fact that its flora has undergone a few changes and is destined to undergo many more in the future. These changes are dependent upon the destruction of the original flora by fire, clearing, artificial drainage, and that more or less natural drainage which is slowly occurring in the lake region. Pasturage is another factor aiding in the destruction of the original flora. Another factor changing it is the introduction of foreign plants, mainly ordinary weeds of old world origin which are ubiquitous, and in part, native plants. The newcomers follow in along the roadways leading from the Dunes Highway to Lake Michigan and along the roads and trails that traverse the more frequented portions of the region.

For the sake of fixing definitely the localities mentioned

in the list the following brief account of the topography of the region is given.

Foredunes. These are low wind blown piles of sand immediately back of the high water mark of Lake Michigan, parallel with the water line. Vegetation on them is not abundant in kind or in amount, but is not inconspicuous. The most characteristic plants are Sand Reed Grass, *Calamovilfa longifolia magna;* Maram Grass, *Ammophila arenaria;* Sand-Cherry, *Prunus pumila;* Wormwood,, *Artemesia caudata* and *A. canadensis.*

Wooded Dunes. These are the characteristic dunes of the region. They are immediately back of the foredunes, ranging in height from 50 to 150 feet above the lake surface. They are covered with an abundant permanent vegetation. According to the predominance of certain plants on them and according to their proximity to the lake the wooded dunes may be roughly divided into a lakeward portion characterized by such plants as White Pine, *Leucopitys strobus;* Jack Pine, *Pinus banksiana;* Juniper, *Juniperus communis;* Red Cedar, *Juniperus virgiana;* Red Osier Dogwood, *Cornus stolonifera,* Aromatic Sumac *Schmaltzia arenaria;* Fox Grape, *Vitus vulpina;* Basswood, *Tilia americana;* Hop Tree, *Ptelea trifoliata;* Choke Cherry, *Prunus virginiana* and some Black and White Oaks, *Quercus velutina* and *Q. alba;* and into a landward portion where the oaks predominate; where there is an abundant floor shrub of Blueberry, *Vaccinium vacillans,* much Witch Hazel, *Hamamelis virginiana;* and a carpet of Pennsylvania Sedge, *Carex pennsylvanica.* The two portions are not sharply defined. The lakeward portion of the dunes is rather uniform in height, 50 to 60 feet above the lake. The vegetation on their north or lake face blends in with that of the foredunes and contains characteristic plants such as Beard Grass, *Andropogon scoparius;* Wild Rye, *Elymus canadensis;* Bugseed, *Coryspernum hyssopifolium;* Gillman's Goldenrod, *Solidago Gillmani.* The landward portions of the wooded dunes vary considerably in height from low open hills and ridges far inland to hills having a height of 100 to 150 feet nearer Lake Michigan. Some of these wooded dunes, particularly the higher ones near Tremont and within the

State Park, support a very luxuriant vegetation. I have designated than as Rich Wooded Dunes. On them are found such plants as Christmas Fern, *Polystichum acrostichoides;* Maiden Hair Fern, *Adiantum pedatum;* Bellwort, *Uvularia grandiflora;* Wakerobin, *Trillium grandiflorum;* Wild Lily-of-the-Valley, *Uniflorum canadense;* Yellow Lady Slipper, *Cypripedium parviflorum;* Long-Bracted Orchid, *Coeloglossum bracteatum;* White Baneberry, *Actea alba;* Blue Cohosh, *Caulophyllum thalictroides;* Bloodroot, *Sanguinaria canadensis.* The rich wooded dunes support a flora which in many respects resembles that of the moist subdunal woods. It is interesting to see the two floras separated by dry dunes.

Blowouts. At various places the wind has worn deep cuts into the first line of wooded dunes, blowing back the sand, leaving a gentle slope toward the lake and a steep slope inland. The flora in the blowouts on the lake face and margins is more or less like that of the foredunes and exposed portions of the first line of wooded dunes. The tops of the blowouts are the only high moving dunes in the region.

Interdunal Meadows and Ponds. These are open treeless stretches between the wooded dunes and mostly toward the landward side. They may occur as permanent meadows, or permanent shallow ponds, or meadows which early in the season were shallow ponds. Often some of the meadows become very dry. The ponds are seldom over knee deep. Around the edges of the permanent or temporary ponds there is usually more or less meadow. Westward of Tamarack Station of the South Shore Line are several of these ponds. Opposite Mineral Springs Station was formerly a very interesting pond known as Little Lake.* It has recently been drained and made into a golf course. West of what was formerly Little Lake is a much larger one known as Walker Lake.

Subdunal Area. Between the tracks of the South Shore Line and the dunes proper is an extensive area of low ground, only a few feet above the level of Lake Michigan. Most of this subdunal area is treeless and constitutes quite a

* Rand McNally's Map of Indiana Dunes, P. S. Goodman, 1920.

marsh, particularly to the east of Tremont. The edge of the subdunal area bordering the dunes may constitute a wet woods or thicket, or less often, it is marshy without trees right to the low open wooded dunes. Near Tremont there is almost a continuous woods from the edge of the dunes to the South Shore tracks. At Keiser and Tamarack stations there are fine subdunal woods adjacent to the railroad. Much of these woods is wet particularly early in the season. These Keiser and Tamarack woods are separated from the dunes proper by the great subdunal marsh. The subdunal woods opposite Mineral Springs station form the very interesting Cowles' tamarack swamp, the only place in the region where are found Showy Lady Slipper, *Cypripedium reginae;* Small White Lady Slipper, *C. candidum;* Yellow Birch, *Betula lutea;* Twin Flower, *Linnaea borealis americana,* and the Dwarf Cornel or Dogwood, *Cynoxylon canadense.* Just south of and bordering the tamarack swamp is the Mineral Springs quaking bog, the only station in the region where are found Arrow Grass, *Triglochin maritima;* Hoary Willow, *Salix canescens;* Pitcher Plant, *Sarracenia purpurea;* Loosestrife, *Decodon verticillatus;* Grass of Parnassus, *Parnassia caroliniana;* Small Fringed Gentian, *Gentiana procera.*

Dune Creek. This is a small sluggish stream draining part of the subdunal area and emptying into Lake Michigan at Waverly Beach, Tremont. Much of its course is in the open, but around Tremont it flows through rich subdunal woods. At its mouth is a small flat delta. At Tremont it receives a tributary from the west.

In the case of plants which are more or less ubiquitous in the region under consideration as determined by observation or by several collected specimens no special localities are mentioned in the following list. In the case of more interesting or unusual plants, definite localities are mentioned using the names of the nearest station of the South Shore Line or such well known landmarks as Little Lake (now obliterated), Walker Lake and Dune Creek.

I am deeply indebted to many persons for assistance in preparing this list. Mr. Charles C. Deam has been most kind in naming plants for me as well as in advising me as

to localities to visit. Rev. J. A. Nieuwland has given similar aid. Dr. Carleton R. Ball has identified all the willows; Prof. A. S. Hitchcock, all the grasses; Mr. Kenneth K. Mackenzie, all the sedges of the genus *Carex;* Dr. S. F. Blake has looked over all the asters, goldenrods, and antennarias; Prof. T. G. Yuncker has named the dodders; Mr. W. R. Maxon has identified several of the ferns and allies; Prof. Paul Weatherwax has kindly furnished one record of a grass hitherto unrecorded from Indiana. I have also to thank Dr. and Mrs. W. D. Richardson, Capt. C. H. Robinson, and other habitués of the dunes for information as to the place of occurrence of interesting plants. I finally have to thank my wife, Dr. Martha Brewer Lyon, who has accompanied me on nearly every collecting trip and aided in the finding of plants and taking care of them.

Botrychium obliquum Muhl., Ternate Grape-fern, subdunal woods and wooded dunes, Tremont.

Botrychium dissectum Spreng., Cut-leaved Grape-fern, rich subdunal woods, Tamarack.

Botrychium virginianum (L.), Virginia Grape-fern, moist subdunal woods, Tremont, Keiser.

Osmunda regalis L., Royal Fern, subdunal marsh, open subdunal woods, edges interdunal ponds.

Osmunda cinnamomea L., Cinnamon-fern, wet subdunal woods.

Osmunda claytoniana L., Clayton's Fern, edge subdunal woods, Furnessville, rare.

Onoclea sensibilis L., Sensitive Fern, subdunal area, moist open spaces, moist open woods.

Filix F. [*ilix*] *fragilis* (L.), Brittle Fern, moist subdunal woods.

Polystichum acrostichoides (Michx.), Christmas-fern,subdunal woods, Keiser, Tremont; rich wooded dunes, Tremont, Mineral Springs.

Dryopteris noveboracensis (L.), New York Fern, subdunal woods, meadows, interdunal meadows.

Dryopteris thelypteris (L.), Marsh Shield-fern, subdunal

marsh, Keiser; quaking bog, Mineral Springs; ditch by railroad, Tamarack.

Dryopteris cristata (L.), Crested Shield-fern, subdunal woods.

Dryopteris spinulosa (Muell.), Spinulose Shield-fern, subdunal woods, Cowles' tamarack swamp; rich wooded dune, Tremont.

Dryopteris intermedia (Muhl.), American Shield-fern, tamarack swamp, Mineral Springs.

Dryopteris hexagonoptera (Michx.), Broad Beech-fern, subdunal woods, Keiser, Tremont.

Anchistea virginica (L.), Virginia Chain-fern, subdunal marsh, edges interdunal ponds; usually in dense stands.

Asplenium platyneuron (L.), Ebony Spleenwort, rich wooded dunes, Tremont, rare.

Athyrium angustum (Willd.), Northern Lady-fern, subdunal woods, Keiser to Tremont; rich wooded dune, Tremont.

Adiantum pedatum L., Maiden-hair Fern, subdunal woods, Keiser to Tremont; rich wooded dunes, Tremont.

Pteridium aquilinum (L.), Brake, open wooded dunes and clearings, subdunal fields; very abundant.

Equisetum arvense L., Field Horsetail, moist subdunal roadside, Tremont.

Equisetum hyemale L., Common Scouring-rush, sides of moving dunes; subdunal wet places.

Lycopodium lucidulum Michx., Shining Club-moss, subdunal woods, Keiser; rich wooded dune, Tremont; rare.

Lycopodium inundatum L., Bog Club-moss, ditch by railroad, Port Chester; rare.

Lycopodium obscurum L., Ground-pine, subdunal woods, Tremont; rare.

Leucopitys strobus (L.), White Pine, lake front of high dunes, rich wooded dunes, subdunal woods.

Pinus banksiana Lamb., Labrador Pine, Jack Pine, lake front of high dunes, rich wooded dunes, subdunal woods.

Larix laricina (DuRoi), Tamarack, subdunal woods at Mineral Springs; formerly also large interdunal pond between Tamarack and Keiser destroyed by fire 1922.

Thuja occidentalis L., Arbor Vitae, tamarack swamp, Mineral

Springs, also two or three trees, subdunal woods at Tamarack.

Juniperus communis L., Juniper, lake face and top of first line high dunes, exposed places on dunes farther inland.

Juniperus virginiana L., Red Cedar, lake face and top first line of high dunes, scattered elsewhere in wooded dunes, and in subdunal woods.

Typha latifolia L., Broad-leaved Cat-tail, subdunal marsh, interdunal ponds, common.

Typha angustifolia L., Narrow-leaved Cat-tail, subdunal marsh, interdunal ponds, much less common than preceding species.

Sparganium eurycarpum Engelm., Broad-fruited Bur-reed, mainly along Dune Creek in marsh, sometimes in wooded portion of creek.

Potomogeton diversifolius Raf., Rafinesque's Poundweed, in 18 inches of water, Little Lake.

Potomogeton sp. Apparently a different species, not fruiting, interdunal pond near Tamarack.

Triglochin maritima L., Seaside Arrow-grass, quaking bog, Mineral Springs.

Alisma subcordatum Raf., American Water-plantain, subdunal marsh, mouth of Dune Creek.

Sagittaria latifolia Willd., Broad-leaved Arrow-head, subdunal marsh, interdunal ponds; depauperate specimens without flowers or fruit in some interdunal meadows.

Sagittaria graminea Michx., Grass-leaved Sagittaria, Little Lake, interdunal ponds, Tamarack; interdunal meadows, Mineral Springs, but not flowering in meadows.

Andropogon scoparius Michx., Broom Beard-grass, dry open places, especially first line of high dunes, also inland, common.

Andropogon furcatus Muhl., Forked Beard-grass, dry open places chiefly inland from the main dunes.

Sorgastrum nutans (L.) Indian Grass, dry open areas, mainly interdunal, inland.

Digitaria sanguinalis (L.), Large Crab-grass, weed, interdunal and subdunal clearings and fields.

Leptoloma cognatum (Schultes), Diffuse Crab-grass, subdunal roadside, Keiser.

Echinochloa Crusgalli (L.), Barnyard-grass, subdunal open places near roads, not yet common but increasing in numbers.

Panicum capillare L., Witch-grass, road across marsh, Tamarack.

Panicum virgatum L., Switch-grass, dry interdunal meadows; open spaces, wooded dunes.

Panicum agrostoides Spreng., Red-top Panic Grass, open woods, moist open places, mainly subdunal.

Panicum depauperatum Muhl, Starved Panic Grass, open wooded dune, Tremont.

Panicum perlongum Nash, Long-stalked Panic Grass, very open wooded dune, Tremont.

Panicum mattamuskeetense Ashe, Clute's Panic Grass, wooded dune, Tremont, specimens in Deam Herbarium and in National Herbarium.

Panicum dichotomum L., Forked Panic Grass, wooded dunes, subdunal woods.

Panicum spretum Schultes, Eaton's Panic Grass, interdunal meadows, subdunal by railroad ditch, Mineral Springs.

Panicum meridionale Ashe, Matting Panic Grass, edge low wooded dune, Baileytown; subdunal by railroad, Tamarack.

Panicum huachucae silvicola Hitchc. and Chase, Hairy Panic Grass, subdunal woods, Tamarack; tamarack swamp, Mineral Springs; wooded dune, Port Chester.

Panicum tennesseense Ashe, Tennessee Panic Grass, edge Walker Lake; rather open spot, rich wooded dune, Tremont.

Panicum pseudopubescens Nash, dry, very open wooded dune, Mineral Springs.

Panicum scribnerianum Nash, Scribner's Panic Grass, wooded dunes, Keiser, Tremont; edge interdunal meadow, Port Chester.

Panicum oligosanthes Schult., Few-flowered Panic Grass, rich wooded dune, subdunal meadow, Tremont.

Panicum clandestinum L., Deer-tongue Grass, dry open along railroad, Keiser.

Panicum latifolium L., Broad-leaved Panic Grass, rather rich wooded dunes, Tremont, Port Chester.

Chaetochloa viridis (L.), Green Foxtail-grass, dry open clearings.

Cenchrus pauciflorus Benth., Bur-grass, dry open clearings, dry subdunal fields, rather rare.

Homalocenchrus oryzoides (L.), Rice Cut-grass, subdunal marsh, Tamarack.

Homalocenchrus virginicus (Willd.), White Grass, subdunal woods, Tamarack, Port Chester.

Phalaris arundinacea L., Reed Canary-grass, subdunal marsh, Mineral Springs, Tremont.

Milium effusum L., Tall Millet-grass, subdunal woods, Keiser.

"*Oryzopsis pungens* (Torr.), Slender Mountain-rice, along side of a dune about ¼ mile east of Waverly Beach, Dunes State Park. May 22, 1926. Identified by Agnes Chase who credits it with being the first report for Indiana, and the most southern station recorded to date. No. 538." Paul Weatherwax.

Stipa avenacea L., Black Oat-grass, open wooded dune, Tremont.

Stipa spartea Trin., Porcupine-grass, low, open wooded dunes, Tremont, Mineral Springs.

Aristida purpurascens Poir., Arrowgrass, dry subdunal clearings, Furnessville.

Aristida tuberculosa Nutt., Sea-beach Triple-awed Grass, open sand of low open wooded dune, Baileytown.

Muhlenbergia racemosa (Michx.), Wild Timothy, subdunal meadow and quaking bog, Mineral Springs.

Muhlenbergia tenuiflora (Willd.), Slender Satin-grass, rich wooded dune, Tremont.

Muhlenbergia foliosa (R. and S.), Wood-grass, subdunal meadow, Port Chester.

Brachyelytrum erectum (Schreb.), Bearded Short-husk, moist subdunal woods, Keiser, Furnessville.

Phleum pratense L., Timothy, subdunal fields and meadows.

Sporobolus cryptandrus (Torr.), Sand Dropseed, sandy subdunal roadside, Baileytown.

Cinna arumdinacea L., Wood Reed-grass, moist subdunal woods, Keiser, Furnessville.

Agrostis perennans (Walt.), Upland Bent-grass, subdunal woods, Tremont, Tamarack.

Agrostis hyemalis (Walt.), Rough Hair-grass, subdunal, moist, open, Keiser, Port Chester.

Agrostis palustris Huds., Red-top,subdunal, moist, open, Tamarack to Port Chester; wooded dune, Port Chester.

Calamagrostis canadensis (Michx.), Blue-joint Grass, subdunal wet places, Mineral Springs, Tamarack.

Calamagrostis inexpansa A. Gray, Bog Reed-grass, subdunal marsh, Mineral Springs.

Calamovilfa longifolia (Hook), Long-leaved Reed-grass, low open wooded dune, inland, Port Chester.

Calamovilfa longifolia magna Scribn. and Merr., abundant in foredune area and high up in blowouts.

Ammophila arenaria (L.), Sea Sand-reed, Marram, foredune area and up into blowouts, less abundant than *Calamovilfa.*

Avena sativa L., Oats, interdunal roadway, Mineral Springs.

"*Danthonia spicata* (L.), Spiked Wild Oat-grass, top of dune nearest lake; about one mile east of Waverly Beach, Dunes State Park, July 11, 1926. Variable in size but often two feet tall. This specimen was first thought to be *D. compressa,* but critical examination by Prof. A. S. Hitchcock shows it to be *D. spicata. D. compressa* has not yet been recorded from Indiana. No. 572." Paul Weatherwax.

Spartina michauxiana Hitchc., Tall Marsh-grass, subdunal, moist, open, Oak Hill.

Phragmites communis Trin., Common Reed-grass, common in patches in subdunal marsh, Tamarack to Mineral Springs.

Eragrostis caroliniana (Spreng.), Pursh's Love-grass, dry open, subdunal, Keiser, Tremont.

Eragrostis pectinacea (Michx.), Purple Love-grass, very open wooded dune, Mineral Springs.

Sphenopholis pallens (Spreng.), Tall Eaton's Grass, subdunal woods, Keiser, Tremont.

Koeleria cristata (L.), Koeler's Grass, common, in open wooded dunes.

Poa annua L., Dwarf Spear-grass, interdunal road, Mineral Springs.

Poa palustris L., subdunal, moist, open, Tamarack, Tremont.

Poa pratensis L., Kentucky Blue-grass, open, wooded dunes.

Poa compressa L., Wire-grass, open wooded dunes, interdunal meadows.

Panicularia canadensis (Michx.), Rattlesnake-grass, subdunal marsh, Tamarack; subdunal woods, Tremont.

Panicularia nervata (Willd.), Meadow-grass, subdunal marsh, Keiser; subdunal woods, Tamarack to Mineral Springs.

Panicularia septentrionalis (Hitchc.), American Flote-grass, subdunal marsh, Keiser, Furnessville.

Panicularia borealis Nash, Northern Manna-grass, subdunal marsh, Tamarack.

Festuca octoflora Walt., Slender Fescue-grass, dry open wooded dunes, dry interdunal meadows, Mineral Springs, Tremont.

Festuca obtusa Spreng., Nodding Fescue-grass, wooded dune, Tremont; subdunal woods, Keiser.

Bromus tectorum L., Downy Brome-grass, dry subdunal, especially along railroad, Tremont.

Bromus ciliatus L., Fringed Brome-grass, half shaded outer edge, Mineral Springs, tamarack swamp.

Bromus purgans L., Hairy Wood-chess, rich wooded dune, Tremont.

Bromus kalmii A. Gray, Kalm's Grass, open wooded dune, Furnessville.

Bromus secalinus L., Common Chess, dry subdunal, Keiser.

Agropyron repens (L.), Couch-grass, dry subdunal, Keiser.

Agropyron caninum (L.), Bearded Wheat grass, rich wooded dunes, Tremont, Mineral Springs.

Triticum aestivum L., Wheat, road across marsh at Keiser.

Elymus virginicus L., Virginia Wild Rye, wet subdunal woods, Tremont.

Elymus striatus Willd., Slender Wild Rye, subdunal woods, Keiser.

Elymus canadensis L., Nodding Wild Rye, open portions and Lake face first line of high dunes, Tremont, also sandy subdunal roadside, Baileytown.

Hystrix hystrix (L.), Bottle-brush Grass, subdunal woods, Keiser, Tremont.

Cyperus Schweinitzii Torr., Schweinitz's Cyperus, dry open places, wooded dunes, subdunal landward side of blowouts, edges interdunal meadows, sandy places, Tamarack to Wilson.

Cyperus strigosus L., Straw-colored Cyperus, subdunal, moist open.

Cyperus filiculmis Vahl., Slender Cyperus, dry subdunal places, open wooded dunes.

Eleocharis olivacea Torr., Bright-green Spike-rush, Walker Lake.

Eleocharis obtusa (Willd.), Blunt Spike-rush, subdunal and interdunal, wet, open, Tamarack to Mineral Springs.

Eleocharis palustris (L.), Creeping Spike-rush, interdunal ponds, Tamarack to Mineral Springs, quaking bog, Mineral Springs.

Eleocharis glaucescens (Willd.), Glaucous Creeping Spike-rush, Dune Creek Mouth.

Eleocharis acicularis (L.), Needle Spike-rush, moist subdunal woods, Tremont.

Fimbristylis puberula (Michx.), Hairy Fringe-style, interdunal meadow, Port Chester.

Fimbristylis geminata (Nees), Low Fringe-style, ditch by railroad, Tamarack.

Fimbristylis autumnalis (L.), subdunal marsh, Tamarack; Walker Lake.

Eriophorum angustifolium Roth, Tall Cotton-grass, subdunal marsh, Port Chester.

Eriophorum virginicum L., Virginia Cotton-grass, subdunal marsh, Port Chester.

Scirpus debilis Pursh, Weak-stalked Club-rush, interdunal pond, Tamarack.

Scirpus Smithii setosus Fernald, Walker Lake.

Scirpus americanus Pers., Chair-makers Rush, Little Lake; subdunal marsh, Mineral Spring.

Scirpus validus Vahl., American Great Bulrush, subdunal marsh, Tremont, Mineral Springs, Little Lake.

Scirpus fluviatilis (Torr.), River Bulrush, Dune Creek marsh, Tremont.

Scirpus atrovirens Muhl., Dark-green Bulrush, subdunal marshy places, Tremont, Mineral Springs.

Scirpus cyperinus (L.), Wool-grass, subdunal marsh, interdunal ponds.

Fuirena squarrosa Michx., Umbrella-grass, Walker Lake.

Dulichium arundinaceum (L.), subdunal marsh, interdunal ponds.

Rynchospora alba (L.), White Beaked-rush, quaking bog, Mineral Springs; Little Lake.

Rynchospora capillacea Torr., Capillary Beaked-rush, Little Lake.

Rynchospora glomerata (L.), Clustered Beaked-rush, wet subdunal meadows, Tremont.

Rynchospora marcostachya Torr., Horned-rush, interdunal ponds, Tamarack, Little Lake

Psilocarya scirpoides Torr., Long-beaked Bald-rush, Walker Lake, wet interdunal meadow, Tamarack.

Mariscus mariscoides (Muhl.), Twig-rush, subdunal marsh, interdunal ponds.

Scleria reticularis Michx., Reticulated Nut-rush, Little Lake, Walker Lake.

Carex convoluta Mackenzie, subdunal woods, Tremont.

Carex Muhlenbergii Schk., Muhlenberg's sedge, open wooded dunes, Keiser to Wilson.

Carex vulpinoidea Michx., Fox Sedge, moist open along Dune Creek.

Carex stipata Muhl., Awl-fruited sedge, subdunal open places and woods, Keiser to Mineral Springs.

Carex bromoides Schk., Brome-like Sedge, wet subdunal woods, Tamarack, Keiser, Tremont.

Carex interior Bailey, Inland Sedge, quaking bog, Mineral Springs.

Carex Howei Mackenzie, Howe's Sedge, subdunal woods, Mineral Springs.

Carex seorsa E. C. Howe, wet subdunal woods, Keiser.

Carex scoparia Schk., Pointed Broom Sedge, subdunal meadow, Keiser, interdunal meadow, Mineral Springs.

Carex cristatella Britton, Crested Sedge, wet subdunal meadow, Tremont.
Carex normalis Mackenzie, Larger Saw Sedge, subdunal moist open, Tremont.
Carex brevior (Dewey), Wilson, dry open.
Carex alata Torr., Broad-winged Sedge, moist open subdunal, Keiser.
Carex pennsylvanica Lam., Pennsylvania Sedge, wooded dunes, common and characteristic.
Carex tetanica Schk., Wood's Sedge, subdunal bog, Mineral Springs.
Carex laxiculmis Schw., Spreading Sedge, subdunal woods, Tremont.
Carex blanda Dewey, Woodland Sedge, wet subdunal meadow, Tremont.
Carex gracilescens Stand., open subdunal woods, Tremont.
Carex heterosperma Wahl., subdunal woods, Keiser.
Carex granularis Muhl., Meadow Sedge, wet subdunal meadow, Tremont.
Carex grisea Wahl., Gray Sedge, wet subdunal meadow, Tremont.
Carex gracillima Schw., Graceful Sedge, subdunal woods and meadow, Keiser.
Carex flexuosa Muhl., Slender-stalked Sedge, subdunal woods, Tremont.
Carex Swanii (Fernald), Swan's Sedge, subdunal meadows, woods, interdunal meadows, Tamarack to Tremont.
Carex aquatilis Wahl., Water Sedge, subdunal marsh, Keiser.
Carex crinita Lam., Fringed Sedge, subdunal woods and marsh, Tamarack to Tremont.
Carex lacustris Willd., Lake-bank Sedge, subdunal marsh, Keiser.
Carex lanuginosa Michx., Woolly Sedge, interdunal meadows, Tremont; open subdunal woods, Mineral Springs.
Carex cryptolepis Mackenzie, subdunal ditch, Keiser.
Carex folliculata L. Long Sedge, subdunal woods and marsh.
Carex lurida Wahl., Sallow Sedge, subdunal wet meadows, Tamarack to Tremont.

Carex intumescens Rudge, Bladder Sedge, subdunal wet meadows, and woods, Tamarack to Tremont.

Carex Asa Grayi Bailey, Gray's Sedge, wet subdunal woods, Tremont.

Carex lupulina Muhl, Hop Sedge, subdunal marsh and wet woods, Keiser, Furnessville.

Arisaema triphyllum (L.), Jack-in-the-pulpit; rather common in subdunal woods, less frequent in rich wooded dunes.

Arisaema dracontium (L.), Green Dragon, moderately frequent, subdunal woods, Tremont, not seen elsewhere.

Peltandra virginica (L.), Green Arrow-arum, swampy subdunal woods, Tremont, rare.

Acorus calamus L., Sweet Flag, subdunal marsh; Dune Creek mouth.

Spathyema foetida (L.), Skunk Cabbage, wet subdunal woods, abundant.

Spirodela polyrhiza (L.), Greater Duckweed, shallow water subdunal ponds, ditches. On September 6, 1926, great quantities of this duckweed were blown and washed ashore along the lake front for several miles near Tremont.

Lemna minor L., Lesser Duckweed, interdunal pond, Tamarack.

Xyris flexuosa Muhl., Slender Yellow-eyed Grass, ditch by railroad, Tamarack, Keiser; Little Lake.

Eriocaulon septangulare With., Seven-angled Pipewort, edges of Little Lake and Walker Lake.

Commelina communis L., Asiatic Day-flower, found once by Dune Creek, near road, not seen next season.

Commelina longicaulis Jacy, *teste* Deam, very open wooded dune along edge of meadow, dry sand, Port Chester, rare.

Tradescantia reflexa Raf., Reflexed Spiderwort, very open wooded dunes, and in open places, mainly inland.

Pontederia cordata L., Pickerel-weed, Little Lake; interdunal pond at Tamarack.

Juncus effusus L., Common Rush, moist subdunal areas, edges interdunal ponds.

Juncus tenuis Willd., Slender Rush, along paths and roads, subdunal woods.

Juncus pelocarpus E. Meyer, Brown-fruited Rush, Walker Lake.

Juncus canadensis J. Gay, Canada Rush, Little Lake, interdunal meadow, Tamarack.

Juncus acuminatus Michx., Sharp-fruited Rush, subdunal wet open places, Tremont, Keiser.

Juncoides intermedium (Thuill.), Common Wood-rush, subdunal woods.

Allium tricoccum Ait., Wild Leek, subdunal woods, Tremont, Keiser.

Allium canadense L., Meadow Garlic, subdunal woods.

Lilium umbellatum Pursh., Western Red Lily, a few dozen plants in an interdunal meadow at Port Chester.

Lilium superbum L., Turk's Cap Lily, subdunal moist open places, subdunal woods, Keiser to Mineral Springs.

Aletris farinosa L., Star-grass, interdunal and subdunal meadows, Port Chester, Mineral Springs.

Asparagus officinalis L., Asparagus, along railroad and subdunal roads.

Vagnera racemosa (L.), Wild Spikenard, subdunal woods and wooded dunes, common.

Vagnera stellata (L.), Star-flowered Solomon's Seal, wooded dunes including top of first line, also in subdunal woods.

Unifolium canadense (Desf.), Wild Lily-of-the-Valley, subdunal woods, also rich wooded dunes.

Uvularia grandiflora J. E. Smith, Large-flowered Bellwort, rich wooded dunes, Tremont; subdunal woods, Keiser, Furnessville.

Polygonatum biflorum (Walt.), Hairy Solomon's Seal, subdunal woods and wooded dunes.

Polygonatum commutatum (R. and S.), Smooth Solomon's Seal, subdunal woods and wooded dunes.

Medeola virginiana L., Indian Cucumber-root, subdunal woods.

Trillium recurvatum Beck, Prairie Wake-robin, subdunal woods, Keiser, Tremont; rich wooded dune, Tremont.

Trillium gradiflorum (Michx.) Large-flowered Wake-robin, subdunal woods, except tamarack swamp, also rich wooded dunes.

Trillium declinatum (A. Gray), Drooping Wake-robin, subdunal woods, Tremont, Keiser, rare.

Smilax herbacea pulverulenta (Michx.), Carrion-flower, subdunal woods, Tremont.

Smilax ecirrhata (Engelm.), Upright Smilax, subdunal woods, rich wooded dunes, Keiser, Tremont.

Smilax rotundifolia L., Greenbrier, subdunal woods, Tremont.

Smilax hispida Muhl., wooded dunes, including lake face, Tremont.

Hypoxis hirsuta (L.), Yellow Star-grass, one plant in an interdunal meadow at Port Chester.

Dioscorea villosa L., Wild Yam-root, subdunal woods and thickets, Tremont.

Iris versicolor L., Larger Blue-flag, subdunal and interdunal open marshy places, occasionally in subdunal woods.

Sisyrinchium albidum Raf., Pale Blue-eyed Grass, low open wooded dune, inland, Baileytown.

Sisyrinchium graminoides Bicknell, Stout Blue-eyed Grass, subdunal woods, Tremont, Mineral Springs.

Sisyrinchium atlanticum Bicknell, Eastern Blue-eyed Grass, edge subdunal woods, Mineral Springs.

Cypripedium reginae Walt., Showy Ladies' Slipper, outer edge tamarack swamp, Mineral Springs.

Cypripedium candidum Willd., Small White Ladies' Slipper, outer edge tamarack swamp, Mineral Springs.

Cypripedium parviflorum Salisb., Yellow Ladies' Slipper, subdunal woods, Tremont, Furnessville; rich wooded dunes, Port Chester, Tremont.

Cypripedium acaule Ait., Moccasin Flower, outer edge, tamarack swamp, Mineral Springs; subdunal woods (not wet areas) Tamarack, rather rare.

Perularia flava (L.), Small pale-green Orchid, wet subdunal woods, Keiser.

Coeloglossum bracteatum (Willd.), Long-bracted Orchid, rich wooded dunes, Tremont.

Gymnadeniopsis clavellata (Michx.), Small Green Wood Orchid, subdunal woods, Tamarack, ditch by railroad, Port Chester, rare.

Limnorchis hyperborea (L.), Tall Leafy Green Orchid, tamarack swamp, Mineral Springs, found but once.

Blepharoglottis lacera (Michx.), Ragged Orchid; subdunal woods, Keiser; interdunal meadow, Port Chester; ditch by railroad, Tamarack, rather rare.

Blepharoglottis ciliaris (L.), Yellow-fringed Orchid, locally common for about 1000 feet along the dune edge of the subdunal marsh, Port Chester; rare in an interdunal meadow, Port Chester, a few plants in ditch by railroad, Port Chester.

Blepharoglottis psychodes (L.), Purple-fringed Orchid, wet subdunal woods, Tremont, Keiser.

Triphora trianthophora (Sw.), Nodding Pogonia, subdunal woods, Tremont, found once.

Limnodorum tuberosum L., Grass-pink; subdunal marsh, Mineral Springs and Port Chester; interdunal meadow, Port Chester; ditch by railroad, Tamarack, rather rare, but locally common at Mineral Springs.

Ibidium cernuum (L.), Nodding Ladies' Tresses, interdunal and subdunal meadows and marshes, common.

Ibidium gracile (Bigel.), Slender Ladies' Tresses, interdunal and subdunal meadows, Port Chester, much less frequent than preceding species.

Peramium pubescens (Willd.), Downy Rattlesnake Plantain rich wooded dunes, Tremont, rather rare.

Liparis liliifolia (L.), Large Twayblade, subdunal woods, Keiser, rich wooded dune, Tremont; rare.

Corallorrhiza maculata Raf., Large Coral-root, subdunal woods, Tremont, rather rare.

Saururus cernuus L., Lizard's Tail, subdunal woods in wet places, Tamarack, Tremont.

Juglans nigra L., Black Walnut, subdunal roadside, Tremont, a few trees, probably planted, doing well and bearing nuts.

Juglans cinerea L., Butternut, rich wooded dunes, Tremont not often bearing nuts.

Carya ovata (Miller), Shellbark Hickory, subdunal woods, Tremont rare.

Comptonia peregrina (L.), Sweet Fern, inland edge subdunal woods, Keiser; rare.

Populus deltoides Marshall, Cotton-wood, foredune area.
Populus gradidentata Michx., Large-toothed Aspen, wet subdunal woods and wet interdunal places, occasionally on wooded dunes.
Populus tremuloides Michx., Quaking Aspen, subdunal and interdunal moist places; common.
Salix nigra Marsh, Black Willow, subdunal woods and swamps.
Salix amydaloides Anders, Peach-leaved Willow, subdunal woods and swamps.
Salix lucida Muhl., Shining Willow, subdunal and interdunal wet places.
Salix fragilis L., Crack Willow, foredune area, Mineral Springs, single specimen.
Salix interior Rowlee, Sandbar Willow, fordune area rare; Dune Creek mouth, moderately common.
Salix glaucophylla Bebb, Blue-leaved Willow, low inland dunes; subdunal and interdunal places.
Salix cordata Muhl. Heart-leaved Willow, moist ground subdunal and interdunal, Mineral Springs.
Salix adenophylla Hook., Furry Willow, foredune area, Furnessville, subdunal along railroad, Wilson, not common at either place.
Salix candida Fluegge, Hoary Willow, quaking bog at Mineral Springs.
Salix petiolaris J. E. Smith, Slender Willow, interdunal meadow, Mineral Springs.
Salix bebbiana Sarg., Bebb's Willow, subdunal swamp, Furnessville, Mineral Springs.
Salix discolor Muhl., Pussy Willow, subdunal and interdunal moist places.
Salix discolor eriocephala Michx., interdunal meadow, Mineral Springs.
Salix humilis Marsh, Prairie Willow, interdunal places, occasionally wooded dunes.
Salix tristis Ait., Dwarf Gray Willow, dry interdunal places, low open wooded dunes.
Carpinus caroliniana Walt., American Hornbeam, subdunal woods, Keiser, Tremont.

Ostrya virginiana (Mill.), Hop-hornbeam, rich wooded dunes, rarely on lake face of dune, Tremont.

Corylus americana Walt., Hazel-nut, subdunal woods and thickets, Tremont.

Betula papyrifera Marsh, Paper Birch, tamarack swamp, Mineral Springs; subdunal field, Keiser; interdunal pond Baileytown; interdunal meadow, Mineral Springs, destroyed by fire 1922; common in tamarack swamp, infrequent elsewhere.

Betula lutea Michx., Yellow Birch, tamarack swamp, Mineral Springs.

Betula pumila L. Low Birch, outer edge tamarack swamp, Mineral Springs; subdunal swamp, Port Chester.

Alnus incana (L.), Speckled Alder, subdunal wet woods, very common.

Fagus grandifolia Ehrb., American Beech, subdunal woods, Tremont and eastward.

Quercus rubra L., Red Oak, wooded dunes, Tremont.

Quercus palustris Du Roi, Swamp Oak,, subdunal swampy woods.

Quercus velutina Lam., Black Oak, wooded dunes and subdunal woods, abundant.

Quercus alba, L., White Oak, wooded dunes and subdunal places, abundant, but less so than preceding species.

Quercus bicolor Willd., Swamp White Oak, subdunal swampy woods, not common.

Ulmus americana L., American Elm, subdunal swampy woods, common.

Ulmus fulva Michx., Slippery Elm, rich wooded dune, Tremont, small trees.

Celtis pumila Pursh, Dwarf Hackberry, first line of wooded dunes, Mineral Springs and westward.

Urtica gracilis Ait., Tall Wild Nettle, subdunal roadways, Oak Hill, Tamarack.

Urticastrum divaricatum (L.), Wood Nettle, subdunal woods.

Adicea pumila (L.), Clearweed, rich subdunal woods, Tamarack. In the herbarium of the University of Notre Dame are the paratypes of *Adicea Deamii* Lunnell, collected in

the Mineral Springs tamarack swamp by Nieuwland. All the dune species are probably referable to *A. Deamii.*

Boehmeria cylindrica (L.), False Nettle, subdunal woods, Tremont, Mineral Springs.

Boehmeria cylindrica scabra Porter, Rough False Nettle, quaking bog, Mineral Springs, rarely in woods.

Comandra richardsiana Fernald, Bastard Toad-flax, open wooded dunes, Tremont, rather common.

Asarum canadense L., Wild Ginger, subdunal woods, Port Chester, not elsewhere.

Rumex acetosella L., Field Sorrel, subdunal fields.

Rumex verticillatus L., Swamp Dock, subdunal marsh, Keiser, Furnessville.

Rumex britannicus L., Great Water Dock, subdunal marsh, Keiser.

Rumex crispus L., Curled Dock, subdunal, dry open, Tremont.

Rumex obtusifolius L., Broad-leaved Dock along roads, subdunal woods, Tamarack.

Tovara virginiana (L.), Virginia Knotweed, subdunal woods, Tamarack to Tremont.

Polygonum aviculare L., Knot-grass, road across marsh, Tamarack.

Polygonum tenue Michx., Slender Knot-weed, dry sand just above subdunal marsh, Port Chester.

Persicaria amphibia (L.), Water Persicaria, interdunal ponds and meadows, Baileytown, Port Chester, Mineral Springs.

Persicaria Muhlenbergii (S. Watson), Swamp Persicaria, subdunal marsh, Keiser, interdunal wet meadows, Baileytown. Mineral Springs.

Persicaria pennsylvanica (L.), Pennsylvania Persicaria, interdunal meadow, Mineral Springs.

Persicaria hydropiperoides (Michx.), Mild Water Pepper, Little Lake.

Persicaria punctata (Ell.), Dotted Smartweed, interdunal meadow, Mineral Springs.

Tracaulon sagittatum (L.), Arrow-leaved Tear-thumb, subdunal marsh, Tamarack to Mineral Springs.

Tracaulon arifolium (L.), Halberd-leaved Tear-thumb, subdunal woods, Keiser.

Tiniaria dumetorum (L.), Copse Buckwheat, subdunal thickets.

Polygonella articulata (L.), Coast Jointweed, open wooded dunes.

Amaranthus retroflexus L., Green Amaranth, by railroad, Port Chester; rare.

Chenopodium album L., Lamb's Quarters, along Dunes Highway, dry and open; Mineral Springs.

Chenopodium leptophyllum (Moq.), Narrow-leaved Goosefoot, open wooded dune, Mineral Springs.

Cycloloma atriplicifolium (Spreng.), Winged Pigweed, open places, first line wooded dunes.

Atriplex hastata L., Halberd-leaved Orache, open subdunal, Mineral Springs; rare.

Corispermum hyssopifolium L., Bugseed, lakeface of first line of high dunes, and blowouts.

Salsola pestifer A. Nelson, Russian Thistle, low dunes, and exposed places of first line higher dunes, roadsides, common.

Phytolacca americana L., Pokeweed, subdunal area at edge of dunes, appearing as a weed in burnt over places; increasing in abundance.

Mollugo verticillata L., Carpet-weed, dry subdunal, Tamarack, infrequent.

Claytonia virginica L., Spring Beauty, subdunal woods, Keiser to Mineral Springs.

Alsine media L., Common Chickweed, subdunal woods, and fields.

Alsine longifolia (Muhl.), Long-leaved Stitchwort, subdunal meadow, Mineral Springs.

Cerastium vulgatum L., Larger Mouse-eared Chickweed, subdunal fields and meadows.

Silene stellata (L.), Starry Campion, subdunal woods, Baileytown.

Silene latifolia (Mill.), Bladder Campion, along railroad, Keiser.

Silene antirrhina L., Sleepy Catchfly, open wooded dunes, Keiser to Mineral Springs.

Silene noctiflora L., Night-flowering Catchfly, subdunal field, Tremont, rare.

Saponaria officinalis L., Bouncing Bet, open place of wooded dune, Tremont, one large patch only.

Brassenia Schreberi Gmel., Water-shield, interdunal pond, Tamarack; also Little Lake, never found in flower. Late in the wet season of 1924 a few leaves were collected in the mud of an interdunal meadow, Mineral Springs.

Nymphaea advena Soland., Large Yellow Pond Lily, interdunal ponds, wet subdunal places, often in wooded portion of Dune Creek, common.

Castalia odorata (Dryand.), White Water Lily, many thriving plants in interdunal pond between Keiser and Tamarack; a few leaves found in Little Lake and in an interdunal meadow at Mineral Springs.

Liriodendron tulipifera L., Tulip-tree, a frequent tree in subdunal woods and rich wooded dunes.

Asimina triloba (L.), Papaw, an occasional shrub or small tree in subdunal woods, Keiser to Tremont; not found fruiting.

Caltha palustris L., Marsh Marigold, common in open subdunal woods and pools and wet meadows.

Coptis trifolia (L.), Gold-thread, fairly common in Cowles' tamarack swamp, Mineral Springs and in subdunal woods at Tamarack; not found elsewhere.

Actaea alba (L.), White baneberry; rather infrequent, subdunal woods, Keiser to Tremont; less frequent, rich wooded dunes.

Aquilegia canadensis L., Wild Columbine, common in subdunal woods and on wooded dunes.

Anemone cylindrica A. Gray, Long-fruited Anemone, common, open wooded dunes.

Anemone canadensis L., Canada Anemone, subdunal meadow, Tremont, found once.

Anemone quinquefolia L., Wind-flower, subdunal woods, rarely in meadow; common.

Hepatica hepatica (L.), Round-lobed Hepatica, common, rich wooded dunes, and subdunal woods.

Hepatica acutiloba DC., Sharp-lobed Hepatica, rare, subdunal woods, Tremont, Port Chester.

Syndesmon thalictroides (L.), Rue-Anemone, fairly common subdunal woods.

Ranunculus delphinifolius Torr., Yellow Water Buttercup, slow flowing water of Dune Creek, not common.

Ranunculus abortivus L., Kidney-leaved Buttercup, subdunal wet woods.

Ranunculus sceleratus L., Celery-leaved Buttercup, subdunal marsh, Keiser; interdunal pond, Oak Hill.

Ranunculus recurvatus Poir, Hooked Buttercup, wet subdunal woods.

Ranunculus pennsylvanicus L., Bristly Buttercup, subdunal marsh, Furnessville.

Ranunculus hispidus Michx., Hispid Buttercup, subdunal woods and open places.

Thalictrum dioicum L., Early Meadow-rue, rich wooded dunes, Tremont, Port Chester.

Thalictrum polygamum Muhl., Late Meadow-rue, subdunal meadows, less often subdunal woods.

Clematis virginiana L., Virginia Clematis, subdunal thickets.

Caulophyllum thalictroides (L.), Blue Cohosh, subdunal woods, Keiser to Port Chester, not common; less frequent on rich wooded dunes.

Podophyllum peltatum L., May Apple, common in large patches, subdunal woods, also on rich wooded dunes.

Menispermum canadense L., Canada Moonseed, subdunal woods and thickets, Keiser to Tremont, not common, not found in flower or fruit.

Sassafras sassafras (L), Sassafras, common trees of wooded dunes.

Benzoin aestivale (L.) Spice bush, subdunal woods.

Sanguinaria canadensis L., Bloodroot, rich wooded dunes, and subdunal woods, Tremont, rather infrequent, not found elsewhere.

Radicula palustris (L.), Yellow Water-cress, subdunal wet places, Keiser to Mineral Springs.

Sisymbrium Nasturtium [*aquaticu*]*m* L., Water-cress, tamarack swamp, Mineral Springs, rare.

Lepidium campestre (L.), Field Cress, open wooded dune, by roadside, Mineral Springs; single specimen.

Lepidium virginicum L., Wild Pepper-grass, subdunal fields, common; roads thru woods and wooded dunes, less frequent.

Norta altissima (L.), Tall Sisymbrium, road thru open woods, Tremont, rare.

Barbarea barbarea (L.), Yellow Rocket, road across marsh, Keiser, rare.

Arabis lyrata L., Lyre-leaved Rock-cress, common and characteristic plant of open wooded dunes.

Arabis glabra (L.), Tower Mustard, wet subdunal meadow, Mineral Springs.

Arabis levigata (Muhl.), Smooth Rock-cress, subdunal woods, infrequent.

Arabis canadensis L., Sickle-pod, rather rich wooded dunes, including first line, Tremont, fairly common and characteristic.

Cardamine pennsylvanica Muhl., Pennsylvania Bitter Cress, subdunal wet open, Keiser, Mineral Springs.

Cardamine Douglassii (Torr.), Purple Cress, wet subdunal woods, Keiser, abundant in places.

Cardamine bulbosa (Schreb.), Bulbous Cress, subdunal wet areas, open and wooded places, Keiser to Mineral Springs.

Dentaria laciniata Muhl., Cut-leaved Toothwort, subdunal woods, Keiser, infrequent, not seen elsewhere.

Cakile edentula (Bigel.), Sea Rocket, lake shore, fore dunes, blowouts, not common.

Polanisia graveolens Raf. Clammy Weed, dry subdunal roadside, Baileytown, not seen elsewhere.

Sarracenia purpurea L., Pitcher-plant, quaking bog, Mineral Springs not common, not found elsewhere.

Drosera rotundifolia L., Round-leaved Sundew, ditch by railroad, Tamarack and Port Chester, rare.

Drosera intermedia Hayne, Spatulate-leaved Sundew, once very abundant along edge of Little Lake; also found at Walker Lake; one season at an interdunal pond between Tamarack and Keiser, but destroyed by fire in 1922.

Penthorum sedoides L., Ditch Stonecrop, subdunal marsh, Keiser, Dune Creek mouth.

Parnassia caroliana Michx., Carolina Grass-of-Parnassus, wet subdunal bog, Mineral Springs, common there, not found elsewhere.

Micranthes pennsylvanica (L.), Swamp Saxifrage, common in wet subdunal woods and meadows, occasionally interdunal meadows.

Heuchera hispida Pursh, Rough Alum-root, wooded dunes, rather rare.

Mitella diphylla L., Two-leaved Bishop's Cap, subdunal woods, not infrequent Tamarack to Tremont, rare on rich wooded dunes, Tremont.

Chrysosplenium americanum Schwein, Water Carpet, rather common in pools of subdunal woods, Tamarack to Tremont.

Hamamelis virginiana L., Witch Hazel, very common and characteristic shrub of the wooded dunes.

Hamamelis virginiana orbiculata Nieuwland, type from Tamarack, and paratype from Mineral Springs, in Nieuwland Herbarium.

Ribes vulgare Lam., Common Currant, edge subdunal woods, Tremont found once.

Ribes americanum Mill., Wild Black Currant, subdunal woods, fairly common.

Ribes americanum mesochora Nieuwland, type and paratype from Mineral Springs, tamarack swamp, in Nieuwland Herbarium.

Grossularia Cynosbati (L.), Wild Gooseberry, subdunal woods and rich wooded dunes.

Platanus occidentalis L., Sycamore, along Dune Creek, and eastward in subdunal woods.

Physocarpus opulifolius (L.), Ninebark, moist subdunal thickets, occasionally interdunal.

Spiraea alba DuRoi, Meadow Spirea, subdunal and interdunal meadows.

Spiraea tomentosa L., Hardhack, subdunal and interdunal meadows, more abundant than preceding species.

Tridophyllum monspeliensis (L.), Rough Five-finger, sub-

dunal marsh and meadow, occasionally interdunal and on wooded dunes.

Potentilla canadensis L., Five-finger, subdunal fields, small plants, more hairy; subdunal woods, tall slender plants, less hairy; both forms common.

Potentilla argentea L., Silvery Five-finger, dry open subdunal sand, Keiser, rare.

Potentilla recta L., Rough-fruited Five-finger, interdunal meadow, Wilson; subdunal field, Tamarack.

Comarum palustre L., Purple Five-finger, subdunal marsh, Tamarack, Furnessville.

Fragaria grayana Vilmorin, Gray's Strawberry, subdunal and interdunal meadows; wooded dunes.

Agrimonia gyrosepala Wallr., Tall Hairy Agrimony, subdunal woods.

Agrimonia parviflora Soland, Many-flowered Agrimony, moist open subdunal places, much more common than preceding species.

Geum virginianum L., Rough Avens, subdunal woods, Tremont.

Geum canadensis Jacq., White Avens, subdunal woods, Keiser to Mineral Springs.

Rubus occidentalis L., Common Blackcap Raspberry, subdunal, Keiser.

Rubus idaeus strigosus (Michx.), Common Red Raspberry, subdunal woods, Keiser, Tremont.

Rubus pubescens Raf., Dwarf Red Blackberry, subdunal woods, Tamarack to Mineral Springs.

Rubus hispidus L., Swamp Dewberry, subdunal woods, Mineral Springs.

Rubus flagellaris Willd., Northern Dewberry, subdunal and open wooded dunes, Mineral Springs, Tremont.

Rubus argutus Link, Highbush Blackberry, subdunal thickets, common.

Rosa palustris Marshall, Swamp Rose, subdunal area, moist and open, common.

Rosa carolina L., Pasture Rose, wooded dunes, common.

Rosa blanda Ait., Meadow Rose, wooded dunes, less common than the two preceding species.

Malus ioensis (Wood), Western Crab-apple, wet subdunal woods, Tremont; open wooded dune, Baileytown.

Adenorachis floribunda (Lindley), Purple Chokeberry, subdunal thickets and swamps, also interdunal, Keiser to Baileytown; common.

Adenorachis melanocarpa (Michx.), Black Chokeberry, subdunal and interdunal moist thickets, Mineral Springs, Tremont, common.

Amelanchier canadensis (L.), Service Berry, subdunal woods and wooded dunes, rather common.

Amelanchier laevis Wiegand, Smooth Service Berry, subdunal woods and wooded dunes, rather common.

Crataegus cuneiformis Jacquin, Large-fruited Thorn, wet subdunal woods, Tremont; single specimen.

Crataegus calpodendron (Ehrh.), Pear Thorn, subdunal woods Tremont; single specimen.

Crataegus coccinea L., Scarlet Thorn, subdunal woods, Keiser; several trees.

Identifications of the three species of Thorn were made by matching up the specimens with plates in Deam's Trees of Indiana.

Prunus angustifolia Marshall, Chickasaw Plum, dry subdunal sand, along New York Central tracks, near Baileytown.

Prunus pumila L., Sand Cherry, fore dune area, blowouts, and occasionally inland, common.

Prunus pennsylvanica L. f., Wild Red Cherry, wooded dunes, including top of first line, subdunal woods. Usually a small tree on the dunes, but often very large in subdunal woods.

Prunus serotina Ehrh., Wild Black Cherry, subdunal woods often a large tree.

Prunus virginiana L., Common Chokecherry, wooded dunes and rather conspicuous on top of first line of high dunes, also subdunal area.

Prunus virginiana demissa (Nutt.), Pubescent Chokeberry, subdunal woods, Tremont labeled "small trees," identified by Deam; Keiser labeled "5m. tree," apparently the same. Not included by Deam in Trees of Indiana but included in Shrubs of Indiana.

Gleditsia triacanthos L., Honey Locust, wooded dune, Tamarack only, about habitation, doing well and apparently spreading.

Baptisia leucantha T. and G., interdunal and less frequently subdunal meadows, Oak Hill, Port Chester.

Lupinus perennis L., Wild Lupine, open places of open wooded dunes, abundant.

Meliotus alba Desv., White Meliot, along road to Waverly Beach; Dune Creek mouth, much more frequent than in 1922.

Trifolium pratense L., Purple Clover, road across marsh at Keiser.

Trifolium hybridum L., Alsatian Clover, interdunal meadow Mineral Springs, rare.

Cracca virginiana L., Wild Sweet Pea, open wooded dunes, inland, common.

Meibomia nudiflora (L.), Naked-flowered Tick-trefoil, subdunal woods and wooded dunes; Furnessville, Mineral Springs.

Meibomia grandiflora (Walt.), Pointed-leaved Tick-trefoil, subdunal woods and wooded dunes, Furnessville, Tremont.

Meibomia sessilifolia (Torr.), Sessil-leaved Tick-trefoil, dry subdunal, Port Chester.

Meibomia paniculata (L.), Panicled Tick-trefoil, Tremont.

Meibomia Dillenii (Darl.), Dillen's Tick-trefoil, subdunal woods, Tremont.

Meibomia canadensis (L.), edge dry woods, Mineral Springs.

Meibomia obtusa (Muhl.), Hairy Small-leaved Tick-trefoil, edge of woods, Mineral Springs.

Lespedeza hirta (L.), Hairy Bush-clover, open places, inland dunes.

Lespedeza capitata (Michx.), Round-headed Bush-clover, open places, inland dunes.

Vicia villosa Roth, Hairy Blue Vetch, abundant in 1926 in subdunal field at Tamarack, not cultivated.

Lathyrus maritimus (L.), Beach Pea, open sand of rear foredune area or lake face of first line of higher dunes, Keiser, Tremont, rather rare.

Lathyrus myrtifolius Muhl., Myrtle-leaved Marsh Pea, subdunal marshy places, Tamarack to Mineral Springs.

Glycine apios L., Wild Bean, subdunal thicket, Tamarack.

Falcata comosa (L.), Hog Peanut, subdunal woods, Tremont.

Falcata pitcheri (T. and G.), Pitcher's Hog Pea-nut, road across marsh, Tamarack.

Strophostyles helvola (L.), Trailing Wild Bean, subdunal area, Tremont.

Geranium maculatum L.,Spotted Crane's Bill, subdunal woods, common.

Geranium carolinianum L., Carolina Crane's Bill, subdunal clearing, Tremont, rare.

Ceratoxalis stricta (L.), Upright Yellow Wood-sorrel, subdunal field, Tremont.

Ceratoxalis cymosa Small, Tall Yellow Wood-sorrel, subdunal woods, Tremont.

Nezera media (Planch.), Stiff Yellow Flax, edge subdunal marsh, Port Chester.

Impatiens biflora Walt., Spotted Touch-me-not, subdunal woods, common.

Zanthoxylum americanum Miller, Prickly Ash, subdunal woods, Keiser to Port Chester, not very common.

Ptelea trifoliata deamiana Nieuwland, Deam's Hop-tree, a common and characteristic shrub of the upper and more open portions of the first line of wooded dunes. Type in Nieuwland Herbarium, from St. Joseph, Michigan.

Polygala cruciata L., Marsh Milkwort, interdunal meadows, Mineral Springs, Port Chester.

Polygala polygama Walt., Racemed Milkwort, open wooded dunes, inland, interdunal meadows, Tremont, Mineral Springs.

Polygala paucifolia Willd., Fringed Milkwort, rich wooded dune, Tremont, rare. A few plants with white flowers also found.

Chamaesyce polygonifolia (L.), Seaside Spurge, foredunes and blowouts, Keiser, Mineral Springs, not common.

Chamaesyce Preslii (Guss.), Large Spotted Spurge, subdunal roadside, Baileytown.

Agaloma corollata (L.), Flowering Spurge, open wooded

dunes from the lake front to edge of subdunal marsh, very variable; abundant.

Tithymalus cyparissias (L.), Cypress Spurge, open spot wooded dune, Tremont, in one large spreading patch associated with *Saponaria officinalis*.

Rhus copallina L., Shining Sumac forming thickets, subdunal area, common.

Rhus typhina L., Staghorn Sumac, woods and thickets, subdunal area, common.

Schmaltzia arenaria Greene, Fragrant Sumac, open wooded dunes, particularly toward the lake front, common and characteristic.

Toxicodendron vernix (L.), Poison Sumac, subdunal swamp, particularly abundant around Mineral Springs, scattered plants elsewhere.

Toxicodendron radicans (L.), Poison Ivy, rich wooded dunes and subdunal woods, common.

Ilex verticillata L., Common Winterberry, subdunal woods and edges interdunal ponds, Tamarack to Mineral Springs, fairly common.

Nemopanthus mucronata (L.), Mountain Holly, subdunal woods, Mineral Springs, interdunal thicket, Oak Hill.

Evonymus obovatus Nutt., Running Euonymus, subdunal woods, and rich wooded dunes inland, rather common.

Celastrus scandens L., Bittersweet, lake side and upper portions first line high dunes, rather common in places.

Acer saccharum Marshall, Sugar Maple, rich wooded dunes, Tremont; only small trees, not found fruiting.

Acer rubrum L., Red Maple, a very common tree of the subdunal woods, occasionally small trees found on rich wooded dunes.

Rhamnus alnifolia L'Heriter, Adler Buckthorn, tamarack swamp, Mineral Springs, rather rare.

Ceanothus americanus L., New Jersey Tea, open wooded dunes, Tamarack to Mineral Springs, common and characteristic shrub.

Vitis aestivalis Michx., Summer Grape, subdunal swampy woods, Tremont.

Vitis aestivalis bicolor LeConte, Bicolor Summer Grape, rich wooded dune, Tremont.

I have insufficient material to determine whether the typical form is confined to subdunal woods, and the variety to wooded dunes.

Vitis vulpina L., Fox Grape, upper and open portions and lake face of first line of wooded dunes, common.

Parthenocissus quinquefolia (L.), Virginia Creeper, rich wooded dunes and subdunal woods, rather common.

Parthenocissus quinquefolia hirsuta (Donn.), subdunal woods, Tamarack, Tremont.

Tilia glabra Ventenat, Basswood, top portion of first line of wooded dunes, where it is a characteristic tree; occasionally in subdunal woods.

Malva rotundifolia L., Running Mallow, subdunal roadside, Baileytown.

Hibiscus moscheutos L, Swamp Rose-Mallow, Dune Creek mouth, not found elsewhere.

Hypericum kalmianum L., Kalm's St. John's Wort, subdunal and interdunal meadows, particularly around Port Chester and Mineral Springs.

Hypericum perforatum L., Common St. John's Wort, along railroad, Tremont.

Hypericum punctatum Lam., Spotted St. John's Wort, subdunal woods, Furnessville, Tremont, moist subdunal sand, Keiser.

Hypericum boreale (Britton), Northern St. John's Wort, interdunal ponds, ditch by railroad, Tamarack to Baileytown, rather common.

Hypericum mutilum L., Small-flowered St. John's Wort, moist open, Tremont, Port Chester.

Hypericum majus (A. Gray), Larger Canadian St. John's Wort, interdunal ponds, Tamarack to Baileytown.

Sarothra gentianoides L., Orange Grass, drying bottom of Little Lake.

Triadenum virginicum (L.), Marsh St. John's Wort, borders of subdunal marsh and interdunal ponds, Tamarack, Mineral Springs.

Helianthemum Walkedae Evans, Hoary Frostweed, open wooded dunes, inland.

Helianthemum majus (L.), Long-branched Frostweed, open wooded dunes.

Hudsonia tomentosa Nutt., False Heather, dry open inland places, fairly common around Wilson and Baileytown; a few plants at Mineral Springs, not found elsewhere.

Lechea villosa, Ell., Hairy Pin-weed, subdunal clearing and interdunal meadow, Tremont; open wooded dune, Port Chester.

Lechea tenuifolia Michx., Narrow-leaved Pin-weed, interdunal meadow, Port Chester.

Viola pedata L., Bird's-foot Violet, dry open inland wooded dunes, common.

Viola sororia Willd., Wooly Blue Violet, subdunal woods, Tremont.

Viola cucullata Ait., Marsh Blue Violet, subdunal marsh and woods, Tamarack to Mineral Springs, common.

Viola sagittata Ait., Arrow-leaved Violet, interdunal meadows, Port Chester, Oak Hill, Wilson, rather infrequent, not found elsewhere.

Viola pallens (Banks), Northern White Violet, subdunal woods, common.

Viola primulifolia L., Primrose-leaved Violet, ditch by railroad, Tamarack, not found elsewhere.

Viola lanceolata L., Lance-leaved Violet, subdunal and interdunal wet meadows, common.

Viola eriocarpa Schwein., Smoothish Yellow Violet, wet subdunal woods, rather common.

Viola pubescens Ait., Downy Yellow Violet, subdunal woods, not wet, and low inland wooded dunes, rather common.

Viola conspersa Reichenb., American Dog Violet, wet subdunal woods, common.

Opuntia humifusa (Raf.), Western Prickly Pear, dry very open, low inland wooded dunes; dry edges interdunal meadows, common.

Rotala ramosior (L.), Tooth-cup, interdunal meadow, Mineral Springs.

Decodon verticulatus (L.), Swamp Loosestrife, quacking bog, Mineral Springs, rare.

Lythrum alatum Pursh, Wing-angled Loosestrife, interdunal meadows, Port Chester, Mineral Springs.

Rhexia virginica L., Meadow Beauty, interdunal meadows, Tamarack to Mineral Springs.

Isnardia palustris, L., Marsh Purslane, subdunal marsh, Keiser.

Ludvigia sphaerocarpa Ell., Globe-fruited Ludwigia, Little Lake.

Ludvigia polycarpa, Short and Peter, Many fruited Ludwigia, Walker Lake.

Ludvigia alternifolia L., Seed-box, subdunal meadow, Keiser, Mineral Springs; low wooded dune, Baileytown, rather pubescent.

Chamaenerion angustifolium (L.), Great Willow-herb, interdunal meadows and burns, rather common.

Epilobium densum Muhl., Linear-leaved Willow-herb, quaking bog, Mineral Springs, interdunal marsh, Baileytown.

Epilobium strictum Muhl., Downy Willow-herb, quaking bog, Mineral Springs.

Epilobium coloratum Muhl., Purple-leaved Willow-herb, subdunal marsh, Keiser.

Oenothera biennis L., Common Evening Primrose, wooded dunes and dry subdunal places, variable.

Raimannia laciniata (Hill), Cut-leaved Evening Primrose, dry open subdunal, Keiser, rare.

Raimannia rhombipetala (Nutt.), Rhombic Evening Primrose, very open wooded low dunes inland, Mineral Springs, Port Chester.

Kneiffia fruticosa (L.), Common Sundrops, interdunal meadows, Port Chester, Mineral Springs.

Circaea lutetiana L., Enchanter's Nightshade, rich woods, mainly subdunal, common.

Circaea alpina L., Smaller Enchanter's Nightshade, subdunal woods, Tamarack, not found elsewhere.

Proserpinaca pulustris L., Mermaid-weed, subdunal marsh, Tremont, interdunal ponds and wet meadows, Tamarack, Mineral Springs.

Aralia racemosa L., American Spikenard, subdunal woods, Keiser, Tamarack, rare.

Aralia nudicaulis L., Wild Sarsaparilla, subdunal woods, rich wooded dunes, common.

Aralia hispida Vent., Bristly Sarsaparilla, edges inland interdunal ponds and meadows, rather infrequent, never found in woods.

Panax quinquefolium L., Ginseng, rich wooded dune, Tremont, single plant.

Panax trifolium L., Dwarf Ginseng, common, subdunal woods, less common on rich wooded dunes.

Eryngium aquaticum L., Rattlesnake-master, interdunal meadows, Mineral Springs, Port Chester, not found elsewhere, common where found.

Sanicula marylandica L., Black Snake-root, subdunal woods, rich wooded dunes, Tremont.

Sanicula gregaria Bicknell, Clustered Snake-root, subdunal woods, rich wooded dunes, Tremont, Port Chester.

Daucus carota L., Wild Carrot, subdunal field, Port Chester, rare.

Washingtonia Claytoni (Michx.), Hairy Sweet-Cicely, subdunal woods, rich wooded dunes, rather common.

Deringa canadensis (L.), Honewort, subdunal woods, Keiser, Tremont.

Angelica atropurpurea L., Great High Angelica, subdunal meadow, Mineral Springs, rare.

Oxypolis rigidius (L.), Cowbane, subdunal marsh and open subdunal woods, Keiser to Mineral Springs.

Thaspium trifoliatum (L.), Purple Meadow-Parsnip, edges subdunal woods, Tremont.

Thaspium barbinode (Michx.), Hairy-jointed Meadow-Parsnip, rich wooded dune, Port Chester, rare.

Zizia aurea (L.), Golden Meadow-Parsnip, subdunal woods, wooded dune, Port Chester.

Cicuta maculata L., Water Hemlock, subdunal marsh, Tamarack to Mineral Springs, common.

Cicuta bulbifera L., Bulb-bearing Water Hemlock, subdunal marsh, Tamarack to Mineral Springs, very rare compared with preceding species.

Sium cicutaefolium Schrank, Hemlock Water-Parsnip, subdunal woods and marsh, Tremont and eastward, rather rare. Mineral Springs, Nieuwland Herbarium.

Cornus alternifolia L. f., Pagoda Dogwood, subdunal woods, Keiser to Tremont, not common.

Cornus rugosa Lam., Round-leaved Dogwood, subdunal woods, Furnessville, rich wooded dunes, Tremont, Mineral Springs.

Cornus Baileyi Coulter and Evans, Bailey's Dogwood; first line wooded dunes, Tremont. One or two specimens seem to be hairy enough to qualify for this species.

Cornus stolonifera Michx., Red Osier-Dogwood, subdunal area, moist open situations; at top first line of wooded dunes, edges of blowuts, abundant.

Cornus racemosa Lam., Gray Dogwood, subdunal and less often interdunal moist thickets, Furnessville to Mineral Springs, locally common.

Cynoxylon floridum L., Flowering Dogwood, subdunal woods and rich wooded dunes, rather common.

Cynoxylon canadense L., Dwarf Cornel., tamarack swamp, Mineral Springs, not common nor found elsewhere.

Nyssa sylvatica Marsh, Tupelo, subdunal and interdunal moist areas, common.

Pyrola secunda Nutt., One-sided Wintergreen, Mineral Springs, Nieuwland Herbarium.

Pyrola americana Sweet, Round-leaved Wintergreen, subdunal woods, rich wooded dunes, Tremont, rather rare.

Pyrola elliptica Nutt., Shin-leaf, subdunal woods, rich wooded dunes, Furnessville to Port Chester, not common but very much more frequent than preceding species.

Chimaphila umbellata (L.), Pipsissewa,, rich wooded dunes, Tremont, Mineral Springs, found twice.

Monotropa uniflora L., Indian Pipe, subdunal woods and rich wooded dunes; common.

Hypopitys lanuginosa Michx., Hairy Pine-sap, subdunal woods, rich-wooded dunes, Keiser, Tremont; infrequent.

Chamaedaphne calyculata (L.), Dwarf Cassandra, borders of interdunal ponds, subdunal marsh, Tamarack, Mineral Springs, locally common.

Epigaea repens L., Trailing Arbutus, edge interdunal meadow, open, Mineral Springs; subdunal woods, wooded dunes, Tremont, relatively infrequent.

Gaultheria procumbens L., Wintergreen, subdunal woods, wooded dunes, interdunal thickets, rather common.

Arctostaphylos uva ursi coatilis Fernald and McBride, Bearberry, open places and summits particularly first line of dunes, less frequent inland, relatively common.

Gaylussacia baccata (Wang.), Black Huckleberry, open wooded dunes, Tamarack, Tremont, Mineral Springs, infrequent.

Vaccinium corymbosum L., Highbush Blueberry, subdunal and interdunal marshy places, relatively common.

Vaccinium pennsylvanicum Lam., Lowbush Blueberry, subdunal woods and wooded dunes, rather frequent.

Vaccinium pennsylvanicum nigrum Wood, dry open wooded dune, Tremont.

Vaccinium vacillans Kalm, Dryland Blueberry, subdunal woods and wooded dunes, very common.

Oxycoccus macrocarpon Ait., Cranberry, quaking bog, Mineral Springs; edge Little Lake; rather rare. 5 miles west of Michigan City and Tamarack, Nieuwland Herbarium.

Samolus parviflorus Raf., Water Pimpernel, Mineral Springs, subdunal ditch, Nieuwland Herbarium.

Lysimachia terrestris (L.), Bulbbearing Loosestrife; subdunal and interdunal wet meadows, locally common.

Steironema ciliatum (L.), Fringed Loose-strife, moist subdunal woods, fairly common; rich wooded dunes, rather rare; Furnessville to Mineral Springs.

Steironema lanceolatum (Walt), Lance-leaved Loosestrife, interdunal meadows, and in what appear to be old dried meadows among wooded dunes, rather common; rich wooded dunes, rather rare; Tremont to Port Chester.

Steironema quadriflorum (Sims), Linear-leaved Loosestrife, subdunal marsh, Mineral Springs, moderately common there, but not found elsewhere.

Naumburgia thysiflora (L.), Tufted Loosestrife, subdunal marsh Mineral Springs and Tamarack, rather rare.

Trientalis americanus Pursh, Starflower, subdunal woods.

Fraxinus americana L., White Ash, wooded dunes, usually near lake, but not on lake face, Tamarack to Tremont.

Fraxinus nigra Marsh, Black Ash, subdunal woods and adjacent wooded dunes, Furnessville.

Gentiana crinita Froel., Fringed Gentian, interdunal meadow, Port Chester, a few plants; not found elsewhere.

Gentiana procera Holm, Smaller Fringed Gentian, quaking bog, Mineral Springs, rare, not found elsewhere.

Dasystephana saponaria (L.), Soapwort Gentian, interdunal meadows, rather common; less frequently, dune edge of subdunal marsh, Mineral Springs, Port Chester.

Dasystephana Andrewsii (Griseb.), Andrews' Closed Gentian, moist open, Tremont; less common than preceding species.

Dasystephana flavida (A. Gray), Yellow Closed Gentian, open inland shrub-covered duneside, Mt. Green, Tremont; woods at edge of interdunal meadow, Mineral Springs, a few plants at each station.

Bartonia virginica (L.), Yellow Bartonia, edge subdunal marsh, Port Chester; subdunal woods, Tamarack; open wooded hillside, Tremont, rather rare.

Menyanthes trifoliata L., Buckbean, subdunal marsh, Tamarack, only a few plants at only one place; not seen in flower or fruit.

Apocynum fol. [*iis*] *androsaemi* L., Spreading Dogbane, wooded dunes, Tamarack to Mineral Springs.

Apocynum cannabinum L., Indian Hemp, low open dunes inland and moist subdunal and interdunal places, Tamarack to Tremont.

Asclepias tuberosa L., Butterfly-weed open wooded dunes and open places, common, variable as to fruit and leaf shape; yellow-flowered specimens rare.

Asclepias incarnata L., Swamp Milk-weed; wet open or partially open places, mainly subdunal, not common.

Asclepias amplexicaulis J. E. Smith, Blunt-leaved Milk-weed, open wooded dune, Oak Hill, rare.

Asclepias Sullivantii Engelm., Sullivant's Milk-weed, Mineral Springs, Nieuwland Herbarium.

Asclepias exaltata (L.), Poke Milk-weed, subdunal woods, and rich wooded dunes, Furnessville, Tremont, infrequent.

Asclepias syriaca L., Common Milk-weed, exposed summits and lake face of first line of dunes, less often open wooded dunes, not very common.

Asclepias verticillata L., Whorlled Milk-weed, very open wooded dunes, in places fairly common.

Acerates viridiflora (Raf.), Green Milk-weed, very open wooded dune, Port Chester, found once.

Acerates floridana (Lam.), Long-leaved Milk-weed, interdunal meadows, found twice.

Convolvulus sepium L., Great Bindweed, subdunal marsh, Keiser to Mineral Springs, rather common.

Cuscuta Coryli Engelm., Hazel Dodder, growing on small herbs, interdunal meadows and subdunal woods.

Cuscuta Gronovii Willd., Gronovius' Dodder, growing on *Impatiens, Saururus, Cephalanthus, Eupatorium, Solidago,* mainly subdunal woods, Tamarack to Tremont.

Cuscuta Gronovii vulgivaga (Engelm.), growing on *Aster* and *Cephalanthus,* subdunal, Tremont.

Cuscuta pentagona Engelm. Five-angled Dodder, subdunal marsh, Tamarack, host undetermined.

Phlox divaricata L., Wild Blue Phlox, subdunal woods, very common; wooded dunes, less common.

Phlox argillacea Clute and Ferris, Midland Downy Phlox, open wooded dunes, rather common.

Phlox bifida Beck, Cleft Phlox, dry open sand of low wooded dunes, inland, Mineral Springs, rather common there, elsewhere not found.

Cynoglossum officinale L., Hound's Tongue, subdunal woods and along railroad, rare.

Lappula virginiana (L.), Virginia Stickseed, open wooded dunes, inland; subdunal woods, rather common.

Myosotis laxa Lehm., Smaller Forget-me-not, subdunal wet open places, not common.

Lithospermum carolinense (Walt.), Gmelin's Puccoon, open wooded dunes and exposed lake face of dunes, common.

Lithospermum canescens (Michx.), Hoary Puccoon, low inland subdunal woods, Baileytown, found once.

Verbena urticifolia L., White Vervain, road across marsh, Keiser.

Verbena hastata L., Blue Vervain, edges subdunal marsh, near dunes, rather common.

Verbena stricta Vent., Hoary Vervain; subdunal roadside, Baileytown.

Teucrium canadense L., American Germander, subdunal marsh at edge of dunes, Tremont, infrequent.

Scutellaria lateriflora L., Mad-dog Skullcap, subdunal woods and marsh, Tremont, Mineral Springs.

Scutellaria galericulata L., Marsh Skullcap, subdunal marsh, Keiser to Mineral Springs.

Nepeta cataria L., Catmint, road across marsh, Mineral Springs.

Prunella vulgaris L., Self-heal, subdunal woods, moderately common.

Stachys aspera Michx., *teste* Deam, seems to resemble more nearly *S. palustris* of Britton and Brown, 1913, Hedge Nettle. Subdunal and less often interdunal marshy places. One specimen from subdunal woods, Tremont, is less hairy than other specimens and has much longer petioles.

Stachys hyssopifolia Michx., Hyssop Hedge Nettle, interdunal meadows, Mineral Springs, Port Chester.

Monarda fistulosa L., Wild Bergamot, subdunal and inland, interdunal meadows, open woods, occasionally on lake face of dunes. Appears to be spreading and more common since 1922.

Monarda punctata L., Horse-mint, open wooded dunes and subdunal and interdunal dry places, very common.

Clinopodium vulgare L., Field Basil, subdunal moist open Keiser, rare.

Koellia virginiana (L.), Virginia Mountain-Mint, subdunal and interdunal open places, Mineral Springs, Port Chester, rather common.

Lycopus uniflorus Michx., Northern Bugle-weed, subdunal and interdunal wet places, Tamarack to Baileytown.

Lycopus rubellus Moench., Stalked Water Hoarhound, subdunal woods, Tremont, Tamarack.

Lycopus americanus Muhl., Cut-leaved Water Hoarhound, subdunal marshy places, Tamarack to Tremont.

Mentha canadensis L., American Wild Mint, subdunal marsh; fairly common.

Physalis virginiana Mill., Virginia Ground-cherry, wooded dunes, inland, Tremont, Mineral Springs; rather infrequent.

Solanum nigrum L., Black Nightshade, low ground, interdunal and subdunal, Tamarack, Mineral Springs; rather rare.

Solanum carolinense L., Horse-Nettle, dry open interdunal and subdunal sand, Tamarack, Tremont; rare.

Solanum dulcamara L., Climbing Nightshade, subdunal woods, rather infrequent, does not give the impression of an introduced weed.

Datura stramonium L., Stramonium, subdunal roadside, Baileytown, rare. The single specimen collected is referable to the form *D. tatula* L.

Verbascum thapsus L., Great Mullen, subdunal clearings, fields and burns, common.

Linaria linaria (L.), Yellow Toad-flax, along New York Central tracks and subdunal roadside, Baileytown, common at that single place.

Linaria canadensis (L.), Blue Toad-flax, open places, low inland dunes, moderately common.

Scrophylaria leporella Bicknell, Hare Figwort, rich wooded dune, Port Chester; along railroad, Keiser; also noticed along subdunal roadsides at Baileytown, rather infrequent.

Chelone glabra L., Turtle-head, wet subdunal and inland open or sometimes wooded places; rather common.

Penstemon calycosus Small *teste* Deam, Long-sepaled Beard-tongue, subdunal meadow, Tremont, about 100 plants in a small patch, found but once.

Mimulus ringens L., Square-stemmed Monkey-flower, open wet subdunal and inland interdunal places, Tamarack to Mineral Springs.

Gratiola virginiana L., Clammy Hedge Hyssop, subdunal marsh, Keiser, Tamarack.

Gratiola sphaerocarpa Ell., Round-fruited Hedge Hyssop, subdunal marsh, Keiser.

Veronica glandulifera Pennell, *teste* Deam, Glandular Brook-

lime, Dune Creek mouth; specimens from Mineral Springs in Nieuwland Herbarium.

Veronica scutellata Schwein, American Brooklime, in water, subdunal marsh, Keiser to Tremont, locally common.

Veronica peregrina L., Purselane Speedwell, road across marsh, Tamarack.

Veronica arvensis L., Corn Speedwell, road across marsh, Keiser.

Buchnera americana L., Bluehearts, interdunal meadow, Port Chester, single specimen.

Dasystoma pedicularia (L.), Fern-leaved False Fox-glove, open wooded dunes, mainly inland; rather common.

Dasystoma virginica (L.), Smooth False Fox-glove, open wooded dunes, mainly inland; rather common.

Agalinis purpurea (L.), Large Purple Gerardia, interdunal and subdunal meadows locally common, especially interdunal meadows at Port Chester.

Agalinis paupercula (A. Gray), Small Flowered Purple Gerardia, ditch by railroad, Tamarack; perhaps only a small flowered form of preceding species.

Agalinis tenuifolia (Vahl), Slender Purple Gerardia, moist subdunal meadow, Tremont, Furnessville, only seen in two places, and there common.

Castilleja coccinea, (L.), Scarlet Painted Cup, interdunal meadow, Port Chester; rather rare.

Pedicularis lanceolata Michx., Swamp Lousewort, subdunal and interdunal meadows and bogs, Tremont to Mineral Springs, rather rare; once found in subdunal woods, Port Chester.

Pedicularis canadensis L., Lousewort, subdunal woods and inland wooded dunes, common.

Melampyrum lineare Lam., Narrow-leaved Cow-Wheat, open wooded dunes, Baileytown, Furnessville, rather infrequent.

Vesiculina purpurea (Walt.) Purple Bladderwort, Little Lake; interdunal pond, Tamarack.

Utricularia gibba L., Small Yellow Bladderwort, Little Lake; interdunal pond, Tamarack.

Utricularia macrorhiza LeConte, Large Yellow Bladderwort, Little Lake; interdunal pond, Tamarack.

Aphyllon uniflorum (L.), Pale Broom-rape, subdunal woods, Tremont, found once.

Conopholis americana (L.f.), Squaw-root, subdunal woods, Tremont, Keiser, found twice.

Leptamnium virginianum (L.), Beech-drops, subdunal woods, Tremont, under oaks; Keiser, under beech; rather rare.

Plantago Rugelii Decne, Rugel's Plantain, roads, subdunal woods, Mineral Springs and elsewhere, not common.

Plantago lanceolata L., Lance-leaved Plantain, subdunal field, Tremont, rare.

Houstonia coerulea L., Bluets, interdunal meadow, Port Chester, common in a few small patches, not found elsewhere.

Cephalanthus occidentalis L., Button-bush, subdunal and interdunal wet places, common.

Mitchella repens L., Partridge-berry, chiefly subdunal woods, not uncommon.

Galium aparine L., Cleevers, subdunal woods, common.

Galium pilosum Ait., Hairy Bed-straw.

Galium circaezans Michx., Cross-Cleavers, subdunal woods, rich wooded dunes, Keiser, Tremont.

Galium labradoricum Wiegand, Labrador Marsh Bed-straw, quaking bog, Mineral Springs.

Galium Claytoni Michx., Clayton's Bed-straw, interdunal meadow, Baileytown, ditch by railroad, Furnessville; subdunal marsh, Tamarack.

Galium concinnum Torr. and Gray, shining Bed-straw, subdunal woods, Tremont, Furnessville.

Sambucus canadensis L., Common Elder, subdunal area, common; occasionally on wooded dunes.

Sambucus racemosus L., Red-berried Elder, tamarack swamp Mineral Springs, where it is common; a few plants are also found in subdunal woods at Keiser and Tamarack.

Viburnum acerifolium L., Maple-leaved Viburnum, subdunal woods, less common on wooded dunes.

Viburnum affine Bush, Missouri Viburnum, rich wooded dune, Port Chester, found once.

Viburnum lentago L., subdunal woods, Keiser to Mineral Springs, not infrequent.

Linnaea borealis americana (Forbes), Twin Flower, tama-

rack swamp, Mineral Springs. Rare. Nieuwland Herbarium.

Lonicera dioica L., Limber Honeysuckle, wet subdunal woods less often open places, Furnessville to Mineral Springs, rather infrequent.

Lonicera prolifera (Kirchner), Grape Honeysuckle, a single specimen without flowers or fruit has been provisionally referred to this species by Mr. C. C. Deam, open wooded dune, Port Chester.

Diervilla lonicera Mill., Bush Honeysuckle, wooded dunes, not uncommon.

Michrampelis lobata (Michx.), Wild Balsam Apple, subdunal clearing, Tremont, found once.

Campanula rotundifolia L., Blue Bell, open wooded dunes, Keiser to Mineral Springs, rather common.

Campanula aparinoides Pursh, Marsh Bellflower, subdunal marsh, Keiser to Mineral Springs; interdunal marsh, Baileytown; not infrequent.

Lobelia cardinalis L., Cardinal Flower, subdunal marshes and ditches, common.

Lobelia syphilitica L., Great Lobelia, subdunal marshes and ditches, less common than preceding species.

Lobelia spicata Lam., Pale Spiked Lobelia, interdunal meadow, Port Chester, about 50 plants together, found once.

Lobelia inflata L., Inflated Lobelia, subdunal open places Keiser, Tremont, infrequent.

Lobelia Kalmii L., Kalm's Lobelia, quaking bog, Mineral Springs.

Krigia virginica (L.), Carolina Dwarf Dandelion, very open dunes, inland; subdunal dryish places, Tremont, Mineral Springs, locally common.

Cynthia virginica L., Virginia Goat's Beard, low open wooded dunes, inland, Tremont, Mineral Springs, not common.

Leontodon taraxacum L., Dandelion, subdunal woods, Keiser.

Leontodon erythrospermum (Andrz.), Red-seed Dandelion; subdunal field, Tremont, common.

Lactuca virosa L., Prickly Lettuce, top of blowout, Tremont; subdunal field, Mineral Springs; dwarf plants on wooded dunes, Tremont, rare.

Lactuca canadensis L., Wild Lettuce, open wooded dunes, subdunal and interdunal meadows and roadsides, becoming more common.

Hieracium canadense Mich., Canada Hawkweed, inland open wooded dunes, less often subdunal meadows, Tremont to Baileytown, rather common.

Hieracium scabrum Michx., Rough Hawkweed, wooded dunes, and open subdunal woods, Tremont, moderately common.

Hieracium Gronovii L., Gronovius' Hawkweed, open wooded dunes, Tremont, Mineral Springs.

Nabalus altissimus (L.), Tall White-Lettuce, subdunal woods and rich wooded dunes, Keiser, Tremont, much less common than next species.

Nabalus albus (L.), White Lettuce, subdunal woods and rich wooded dunes, rather common.

Prenanthes racemosus (Michx.), Glaucous White Lettuce, quaking bog, Mineral Springs; interdunal meadow, Port Chester, infrequent.

Ambrosia trifida L., Great Ragweed, subdunal roadside, Baileytown, rare.

Ambrosia elatior L., Ragweed, subdunal waste areas, not common; less frequently in woods and lake face of dunes, Tremont, Mineral Springs.

Xanthium pennsylvanicum Wallr., Pennsylvania Clotbur, road across marsh, Keiser, rare.

Vernonia fasciculata Michx., Western Iron-weed, subdunal and interdunal meadows, Tremont, Port Chester, common.

Eupatorium purpureum L., Joe-Pye Wood, subdunal moist places, common.

Eupatorium serotinum Michx., Late-flowering Thorowort, subdunal fields and meadows, Port Chester, Baileytown, not common.

Eupatorium sessilifolium L., Upland Boneset, open wooded dunes, Mineral Springs, Tremont, not common.

Eupatorium perfoliatum L., Boneset, subdunal woods and moist open places, Keiser to Mineral Springs, rather common.

Eupatorium urticaefolium Reichard, White Snake-root, subdunal woods, rich wooded dunes, Tremont, infrequent.

Kuhnia eupatorioides L., open places, wooded dunes, usually

near the lake face, Tremont, Mineral Springs, moderately common.

Lacinaria cylindracea (Michx.), Cylindric Blazing Star, rather open wooded dunes, mainly inland, Tremont, infrequent.

Lacinaria scariosa (L.), Upland Blazing Star, open wooded dunes, common.

Lacinaria spicata (L.), Lowland Blazing Star, subdunal and interdunal moist meadows, mainly around Mineral Springs, common.

Solidago caesia L., Wreath Golden-rod, mainly subdunal woods, not common.

Solidago uliginosa Nutt., Bog Golden-rod, subdunal areas, usually moist, Mineral Springs to Tamarack.

Solidago speciosa angustata T. and G., Narrow Showy Golden-rod, open wooded dunes, Tremont, Mineral Springs, common. The typical form *S. speciosa speciosa* (Nutt.) apparently does not occur in the region. Most of my specimens were labeled *angustata* by Dr. Blake and the others "toward *angustata*."

Solidago Gillmani (A. Gray), Gillman's Golden-rod, upper foredune area and lake face wooded dunes, moderately common.

Solidago rugosa Mill., Wringle-leaved Golden-rod, subdunal and interdunal open wet places, Tamarack to Baileytown, rather common. Rarely in woods, in which cases the leaves are much thinner.

Solidago patula Muhl., Rough-leaved Golden-rod, subdunal marsh, fairly common, occasionally in subdunal woods.

Solidago ulmifolia Muhl., Elm-leaved Golden-rod, subdunal woods, Port Chester to Tamarack.

Solidago canadensis L., Canada Golden-rod, open subdunal and interdunal places.

Solidago serotina Ait., Late Golden-rod open subdunal and interdunal places.

Solidago serotina gigantea (Ait.), Large Late Golden-rod, open subdunal and interdunal areas, apparently more common than the typical form.

Solidago altissima L., Tall Golden-rod, subdunal marsh.

Solidago nemoralis Ait., Gray Golden-rod, open wooded dunes and dry interdunal meadows, common.

Euthamia graminifolia (L.), Bushy Golden-rod, subdunal and interdunal meadows, rather common.

Euthamia graminifolia Nuttalli (Greene), Nuttall's Bushy Golden-rod, railroad ditch, Tamarack.

Euthamia tenuifolia (Pursh), Slender Fragrant Golden-rod, subdunal and interdunal marshy places, locally common.

Aster macrophyllus L., Large-leaved Aster, subdunal woods and rich wooded dunes, rather common.

Aster macrophyllus pinquifolius Burgess, subdunal woods, Tremont.

Aster furcatus Burgess, Forked Aster, subdunal woods, Tremont. Specimen in Blake Herbarium.

Aster azureus Lindl., Sky-blue Aster, open wooded dunes, rather common, occasionally interdunal meadows, Tremont, Mineral Springs.

Aster cordifolius L, Blue Wood Aster, subdunal woods, Furnessville.

Aster sagittifolius Willd., Arrow-leaved Aster, wooded dunes, subdunal woods, Tremont, Mineral Springs.

Aster novaeangliae L., New England Aster, subdunal marshy places, common.

Aster puniceus L., Red-stalked Aster, subdunal marshy places, Mineral Springs to Tamarack.

Aster near *concinnus* Willd., Smooth Aster, quaking bog, Mineral Springs.

Aster junceus Ait., Rush Aster, subdunal marsh, Tamarack to Mineral Springs.

Aster novibelgii L., New York Aster, moist open, Mineral Springs.

Aster longifolius Lam.?, Long-leaved Aster, subdunal marsh, Tamarack.

Aster dumosus L., Bushy Aster, interdunal meadows, Port Chester.

Aster lateriflorus L., Starved Aster, subdunal woods and meadows, Tremont, Furnessville.

Aster vimineus Lam., Small white Aster, subdunal meadow, Tremont.

Aster salicifolius Ait., Willow-leaved Aster, subdunal meadows, less often woods, Tremont, Tamarack.

Aster paniculatus Lam., Panicled Aster, subdunal marsh, Tamarack.

Aster Tradescanti L., Tradescant's Aster, subdunal meadow Tremont.

Aster ericoides platyphyllus T. and G., White Heath Aster, subdunal meadow, Tremont.

Aster ericoides villosus T. and G., Hairy Heath Aster, subdunal meadow, Tremont.

Erigeron pulchellus Michx., Robin's Plantain, interdunal meadow, Mineral Springs.

Erigeron philadelphicus L., Philadelphia Fleabane, subdunal meadow, Mineral Springs.

Erigeron annuus (L.), Sweet Scabious, interdunal meadow, Mineral Springs.

Erigeron ramosus (Walt.) Daisy Fleabane, dry open grass covered dunes, Tremont; interdunal meadow, Mineral Springs.

Leptilon canadense (L.), Canada Fleabane, interdunal meadow, and subdunal open places, a weed, increasing in numbers.

Doellingeria umbellata (Mill.), Tall Flat-topped White Aster, subdunal woods and marshes, Tremont, Mineral Springs, locally common.

Ionactis linariifolius (L.), Stiff-leaved Aster, open wooded dunes, common.

Antennaria fallax Greene, Deceitful Cat-foot, wooded dunes and open places, common.

Antennaria Parlanii Fernald, Parlin's Cat-foot, wooded dune, Tremont.

Antennaria plantaginifolia (L.), Plantain-leaved Cat-foot, open wooded dunes and edges interdunal meadows.

Antennaria neglecta Greene, Field Cat-foot, interdunal meadow, Port Chester.

Gnaphalium obtusifolium L., Sweet Everlasting, interdunal meadows, low open wooded dunes, rather common.

Inula helenium L., Elecampane, edge subdunal woods, Tremont, rare.

Silphium integrifolium Michx., Entire-leaved Rosin-Weed, subdunal area.

Rudbeckia hirta L., Black-eyed Susan, interdunal meadows, common, becoming more so and invading wooded dunes.

Rudbeckia laciniata L., Wild Golden-glow, mainly subdunal moist open places, common.

Helianthus petiolaris Nutt., Prairie Sunflower, along Dunes Highway, and on top of blowout, Mineral Springs, rather rare and local but evidently increasing in numbers.

Helianthus occidentalis Riddell, Few-leaved Sunflower, very open and low inland wooded dunes, Port Chester, Mineral Springs, common.

Helianthus grosse-serratus Martens, Saw-tooth Sunflower, subdunal marshy places, Port Chester.

Helianthus divaricatus L., Woodland Sunflower, wooded dunes, rather common.

Helianthus decapetalus L., Thin-leaved Sunflower, subdunal woods and wooded dunes, much less frequent than preceding species.

Coreopsis lanceolata L., Lance-leaved Tickseed, very open wooded dune, Port Chester; common there, not seen elsewhere.

Coreopsis tripteris L., Tall Tickseed, subdunal, interdunal meadows, inland wooded dunes, rather common.

Coreopsis palmata Nutt., Stiff Tickseed, open spaces and low inland wooded dunes, Port Chester, Mineral Springs, Baileytown, infrequent.

Bidens connata Muhl., Purple-stemmed Swamp Beggar-tick, interdunal meadows, Tamarack, Mineral Springs, not very common.

Bidens comosa (A. Gray), Leafy-bracted Tickseed, road across marsh, Tamarack, not common.

Bidens discoidea (T. and G.), Small Beggarticks, edge wet subdunal woods, Baileytown, not common.

Bidens trichosperma (Michx.), Tall Tickseed-Sunflower, subdunal and interdunal meadows, Tamarack to Mineral Springs, very abundant, varies much in height.

Bidens aristosa (Michx.), Western Tickseed-Sunflower, subdunal moist meadow, Tremont.

Helenium autumnale L., Sneezeweed, subdunal road, Keiser, Port Chester, rare.

Achillea millefolium L., Yarrow, subdunal open dryish places, occasionally interdunal meadows, Port Chester, Tremont, not common, but increasing in numbers.

Anthemis cotula L., Fetid Camomile, road across marsh, Tamarack, found in one small patch.

Chrysanthemum leucanthemum L., White Daisy, subdunal area, Tremont, not common.

Chrysanthemum balsamita L., Costmary, subdunal clearing, Tremont, one small patch.

Tanacetum vulgare L., Tansy, subdunal clearing, Tremont, one patch.

Erechtites hieracifolia (L.), Fire-weed, interdunal meadow, mineral Springs, not common.

Artemesia caudata Michx., Wild Wormwood, foredune area, and open wooded wooded dunes, Keiser to Mineral Springs, common.

Artemesia canadensis Michx., Canada Wormwood, foredune area, Keiser to Mineral Springs, much less common than preceding species.

Mesadenia atriplicifolia (L.), Pale Indian Plantain, open wooded dunes, moderately common.

Senecio plattensis Nutt., Prairie Ragwort, open wooded dunes, Tremont, Mineral Springs, moderately common.

Senecio aureus L., Golden Ragwort, subdunal marsh, Keiser; subdunal woods, Tamarack, infrequent.

Arctium minus Schk., Common Burdock, subdunal roadside, infrequent.

Cirsium altissimum (L.), Roadside Thistle, open woods, rich wooded dunes, Tremont, Mineral Springs, not common.

Cirsium discolor (Muhl.), Field Thistle, subdunal meadow and thickets, Tremont, Port Chester, infrequent.

Cirsium Pitcheri (Torr.), Pitcher's Thistle, blowouts, and lake face of dunes, fairly common at Keiser, rare elsewhere.

Cirsium muticum Michx., Swamp Thistle, subdunal meadows, Tremont, Mineral Springs, rather common.

Cirsium arvense (L.), Canada Thistle, roadside across marsh, Mineral Springs; interdunal meadow, Baileytown, infrequent, not seen before 1925.

THE MARSH HAWK

BENJAMIN FRANKLIN BUSH

Harris in his "Birds of the Kansas City Region," says the Marsh Hawk is seen ranging over the Missouri River Bottoms from March 12 to April 15, and that two birds remained near the Country Club District the entire winter of 1916-1917, and though formerly a rare breeder in this vicinity, it has not been found nesting here for several years. My own observations of this species are, that the birds are present along the Missouri River Bottoms throughout the year, but are more numerous during Spring and Autumn.

Shirling in his "Birds of Swope Park," says that the Marsh Hawk probably does not nest in the Park, but occasionally uses it for a hunting ground. Widmann in his "Catalogue of the Birds of Missouri," says that the Marsh Hawk was undoubtedly formerly a very common Summer resident in the prairie region of Missouri, and that Audubon met with it near the Northwest corner of the State, May 6, 1843; that Carver found it breeding in Clark County in the nineties and that it is reported as breeding from Kansas City and Montgomery City; and that the last record comes from St. Charles County, June, 1905, where in the tall grasses of the Club grounds it still succeeded in raising a brood.

Coues in his "Great Key to North American Birds," says that the nest of the Marsh Hawk is placed on the ground, and rather neatly built of hay, a foot in diameter, three inches high; eggs 3-6, commonly 4-5, broad and equal-ended, 1:80 to 1:90 inches long, dull white.

Davies in his "Nests and Eggs of North American Birds," says the Marsh Hawk is one of the most abundant and widely-diffused of our birds, and is found especially in swampy prairies or marshy places; and that the nest may be found,

placed on the ground, which is only a collection of twigs and hay, and from three to seven inches in height, and a foot or more in diameter, and that sometimes the nests are of larger proportions, which is the result of nesting in the same spot for a number of years; that the eggs are from three to six in number, and may be found from the first of May to the 20th of June.

From the above quotations we gather that the Marsh Hawk is not only common where it occurs, but that it also is a wide-spread species, not uncommon even in the Winter, more abundant in the Spring and Autumn, and that it breeds in marshy or swampy grounds, but no positive information as to its nesting in the Kansas City region; and no collection of eggs is known prior to this time.

On the West side of the Missouri River just opposite Courtney, Missouri, there is a long tract of low swampy bottom, some five miles long and one-fourth to one mile wide, that is overflowed by the river several times every year. This tract is densely overgrown with small willows, with now and then an occasional cotton-wood, elm or sycamore, and interspersed with thickets here and there of cornel, yearling sycamores and box-elders and young elms, and an endless patch of low smartweeds, with here and there great patches of *Equisitum*.

The small willows grew so thickly that the greater part of them have died and fallen down in a strangely confusing entanglement for those who attempt to traverse this tract.

On May 21st, accompanied by my son, I visited this wilderness to see what might be found there, and we were soon in an apparently interminable thicket, where it was almost impossible to make our way for the fallen willows, the giant ragweeds and great smartweeds; the day was a most perfect one for May, and the riot of bird-songs and noises was almost indescribable. The Whiteeyed Vireos filling the air with their trilling songs, whilst the erratic Yellow-breasted Chats were cutting their fantastic capers in the air, the Maryland Yellowthroats were pouring forth their rollicking airs, the gayly-colored Towhees were chasing each other from clump to

clump, and the Acadian Flycatchers were sending forth their plaintive "pe-as" to each other.

While making our way through a tract of densely fallen willows to reach the high bottom, we flushed a Marsh Hawk from its nest on the ground in the midst of a patch of low smartweeds and more or less brush. We left the nest then, and continued on our way to the high bottom and great levee there, and after several hours returned to the nest and again found the bird on it.

There were six eggs in the nest, and an examination of the nest showed that it had been used for several reasons, the upper nest being quite new, and made of fine smartweed stems, a few grass stems and some slender willow twigs; the one just under this nest was composed of quite similar materials and was much older, but still in good condition, whilst the bottom nest was much too rotten to be taken up.

This nest, its formation, the number of eggs, their size, shape and color, agree with everything that the writers above-mentioned have said of the Marsh Hawk, and this is the first definite knowledge we have of this species nesting in the Kansas City region.

BOOK REVIEWS

American Silurian Crinoids, by Frank Springer. Smithsonian Institution, Publication 2871. Washington, 1926.

This quarto volume of 239 pages and 33 plates is devoted particularly to the Silurian crinoids of Tennessee and Indiana. Because of their importance in Tennessee strata, a few blastoids and cystoids also are described. More than half of the species of crinoids belong to the Camerata. Seven new genera are proposed, and important new information is given concerning several others.

The discussion of the Flexibilia is limited, since Mr. Springer has but recently published a monograph on that order. One is surprised, however, to notice the importance of this group, whose members generally are considered rare. *Pynosaccus*, a genus typical of the Silurian of England and Gotland, is abundant in the Beech River formation of Tennessee, with one species barely distinguishable from its European prototype.

The most important development among the Inadunata is the abundance of good material representing the Calceoccrinidae, reef-dwelling types whose evolution is for the first time made plain. In view of the family ending which Springer gives to their name, however, it is a little surprising to find them within the Heterocrinidae. But this may be better than Jaeckel's proposal to raise them to the rank of suborder—the Calceocrinites.

One interesting feature of the book is the brevity of the species descriptions. Springer believes, when adequate pictures are published, that tables of dimensions "are usually only a pedantic incumbrance.' Whether this conclusion can be extended to other groups than the crinoids, and to other methods of treatment than the systematic monograph is a little doubtful. But his major contention, that most descriptions are cumbersome, cannot be questioned. One problem which paleontologists must face is that of devising some sort of description which will be at once adequate, brief, and useful in work of comparison.

—C. L. F.

On the Fossil Faunas from Per Schei's Series D from Ellesmere Land, by I. P. Tolmachoff. Report of the Second Norwegian Arctic Expedition in the "Fram" 1898-1902. No. 38. Oslo, 1926.

The stratigraphic significance of the Devonian fossils collected by Per Schei during the two seasons that the Fram wintered in Goose Fjord, Ellesmere Land, long has been in doubt. Meyer, who described the brachiopods, concluded that they belonged to strata ranging from lower Helderberg to "Carboniferous." Loew, working on the corals, found species in Horizon D, called upper Devonian by Meyer, to be dominantly middle Devonian in aspect. Per Schei himself thought that the Devonian extended below his Series D.

Dr. Tolmachoff has studied the fossils, mainly molluscs, trilobites and ostracods, which comprise the chief remaining portion of Per Schei's Devonian collections. Paucity of specimens has hampered his work; and rather than leave forms unidentified, or risk misuse of established specified names, Dr. Tolmachoff has made new species freely. Fortunately, however, he has introduced ample comparisons with forms already described, and the illustrations which he gives are excellent.

From the material at hand, and from his analyses of the reports by Loew and Meyer, Tolmachoff feels forced to revise the earlier opinions on the correlation of the Ellesmere Deconian (Series D) with that of Europe and America. Evidence for Helderbergian age of the lower strata he finds to be doubtful; the horison Db is mainly middle Devonian. Meyer's "Carboniferous" brachiopods from the uppermost member, Di, he concludes to be erroneously labeled, since they lie in rock wholly unlike any in the true Di, whose fossils point toward earliest late Devonian age. Thus he restricts the period covered by Series D to middle and earliest late Devonian, with the possibility of some early Devonian in the lowermost members.

The chief relationships of the faunas, particularly those of the upper members, are with faunas of the eastern half of North America. Thus the dominant ostracod is *Bythocypris devonica* Ulrich, of the Ohio Valley, while the gastropods are of markedly American aspect. The most westerly relationships appear in a pteropod which resembles one described by Cleveland from Milwaukee. However, this probably is a Hamilton rather than a Cedar Valley form, so that the relationship remains eastern despite locality. C. L. F.

Whisperings of the Caribbean. By Joseph J. Williams, S. J., Benziger Bros. Price $2.00.

The island of Jamaica,—its history, topography, geology, and the habits, customs and spiritual life of the inhabitants, form the subject matter of this volume of two hundred and fifty pages. The geologist and meterologist will be interested in the chapters on earthquakes and hurricanes, and the anthropologist will find the chapters on Anancy stories and bush funerals valuable. The four remaining chapters are historical. The purpose of the author seems to be to arouse interest in Columbus' "Garden of the Indies" rather than to present a detailed account of any special features connected with his subject.—F.J.W.

Taxidermy and Museum Exhibition. By John Rowley.—D. Appleton and Co., N. Y.

When an author packs the results of a half century of work into a book, we expect that book to be standard on the subject of which it treats. Such a book is the one in question. The volume of 325 pages is the most exhaustive presentation of the subject known to us. In nine interesting chapters, the author discusses every phase of the taxidermist's art. We are told what outfit to use for collecting—guns, traps, poisons,—what tools and materials to use in the preparation of specimens, how to make casts and moulds, how to skin the various animals, and, finally, how to mount them in life-like positions. The book is simply and interestingly written,—a record of personal work rather than a compilation of other men's experiences. —F. J. W.

Heredity. By A. F. Schull. McGraw-Hill Book Co., N. Y.

This book attempts to present a rather difficult and special branch of biology to those who have no previous knowledge of any phase of biology. The attempt seems to be successful. At any rate, the reader who comes to the work unprepared will get at least some notions of general biology. While we do not believe that heredity should be taught except to those who know at least the fundamentals of general biology, we are not prepared to say that the book fails in attaining its objective. It is well written and illustrated and gives sound scientific doctrine to a class of readers that would not otherwise be reached. A helpful glossary is appended. —F. J. W.

The American Midland Naturalist

PUBLISHED BI-MONTHLY BY THE UNIVERSITY OF NOTRE DAME,
NOTRE DAME, INDIANA

VOL. X. JULY, 1927. No. 10.

CONTRIBUTIONS TO THE BOTANY OF MICHIGAN, NO. 13

Notes on Grasses of Michigan and some others.

OLIVER ATKINS FARWELL

Bromus ramosus Huds. Rough Chess. This is the *B. asper* Murray. In the herbarium of *Parke, Davis & Co.*, there is a sheet of this grass from Michigan, without locality, collected by Dr. H. H. Rusby in August, 1884.

Eragrostis Eragrostis (Linn) MacM. Stink Grass. This species has a voluminous synonymy but it is not at all unique in this respect. *E. major* and *E. minor* were united by Trinius under *E. major* and this procedure was followed by others. Under the International Rules, *E. major* must be taken and maintained as the type of the united species; but *major* is not the oldest or proper specific name. Under the International Rules the proper binomial is *E. multiflora* (Foersk.) Aschers, since the earlier *E. multiflora* (Roxb.) Trin. is only a synonym of *E. rubens* (Lam.) Hochst. The designation at the head of this paragraph, however, is the proper name for those who have no objections to the use of duplicate names. *E. Eragrostis* (Linn) Karst. is an earlier name but it also is reduced to synonymy when *E. major* and *E. minor* are united. MacMillan's name is based upon *Briza Eragrostis* Linn, Sp. Pl. 1 (1753) I 70, while Karsten's name is based upon *Poa Eragrostis* Linn, l. c., 68. The plant is often low and geniculate, some of the culms prostrate and matting. Panicles close and compact. Shelbyville No. 5952, July 31, 1921; Ypsylanti, No. 1201, August 12,

1891; Detroit, No. 1201a, August 26, 1892; Parkedale, No. 3007, August 4, 1912.

Eragrostis Eragrostis subvar. *Leersioides* (Presl.) N. Comb. *Eragrostis multiflora* var. *Leersioides* (Presl.) Richter. *Poa Cilianensis* All., Fl. Pied. (1785) II 246 and III t. 91. f. 2. Usually taller and less geniculate, panicle loose, open, spikelets fewer-flowered often only 2 or 3 flowered. Shelbyville, No. 5953, July 31, 1921.

Eragrostis Eragrostis var. *microstachya* (Coss. & Germ.) N. Comb. *E. vulgaris* b. *microstachya* Coss & Germ., Fl. Par. (1845) II 241. *E. minor* Host. Spikelets narrower and more loosely flowered than in the typical form of the species. Detroit, No. 1944-½, August 23, 1905.

Eragrostis spectabilis (Pursh) Steud. *Er. pectinacea* var. *spectabilis* A. Gr. Pursh's name is the oldest valid name applicable to this species. In the typical form the sheaths are glabrous.

Eragrostis spectabilis var. *sparsihirsuta* N. Var. Sheaths more or less hirsute or villous. This is the *Eragrostis pectinacea* Nees, Steud., A. Gr., etc., but not the *Poa pectinacea* Mx. whose name they misapplied.

Eragrostis pilosa (Linn) Beauv. An annual introduced from Europe. Widely distributed. Detroit No. 1560, September 20, 1896; Monroe, No. 6696, August 22, 1923; Detroit (Redford) No. 7241, October 8, 1924.

Eragrostis pilosa (Linn) Beauv., var. *Caroliniana* (Spr.) Farwell. *Poa pectinacea* Mx., Fl. Bor. Amer. (1803) I 69. *P. Caroliniana* Spr. *E. Purshii* (Bernh.) Schrad. Undoubtedly the *Poa pectinacea* of Michaux is the plant that has been known generally as *E. Purshii.* Michaux's plant came from Illinois and he described it as an annual with the palets persistent on the rachis after the falling of the seeds and lemmas. No other plant answers as well to this character which is the one that gave rise to the specific name. It is not observed, or rarely so, in the species (which is a perennial) to which Nees, Steudel, A. Gray and others misapplied Mich-

aux's name; in that the rachis breaks up and the flower falls away with its section. This is scarcely varietally distinct from the European *Eragrostis pilosa* (Linn) Beauv. It is one of our common grasses in waste grounds and old fields that were once cultivated. Detroit, No. 1437, September 2, 1893; Monroe Piers, No. 4563, September 9, 1917; River Rouge, No. 5144, September 15, 1918; Detroit, No. 5144a, September 15, 1919; Detroit (Oakwood) No. 5133, September 15, 1918; Royal Oak, No. 5589d, August 12, 1920; Shelbyville, No. 5955, July 31, 1921; Monroe, No. 6719, August 22, 1923; Whitmore Lake, No. 6774, September 5, 1923; La Salle, No. 7182, September 17, 1924; Flat Rock, No. 7495, July 29, 1925. Also collected at Chicago, Ill., No. 5097, August 20, 1918.

Eragrostis amabilis (Linn) O. K., Rev. Gen. Pl. (1891) I 773-'4. *Poa amabilis* Linn, Sp. Pl. Ed. I (1753) I 68. *E. tenella* (Linn) Beauv. ex. R. & S., Syst. (1817) II 576 not *Poa tenella* Linn., Sp. Pl. Ed. 1 (1753) I 69. *E. plumosa* (Retz) Link, Hort. Berol. (1827) I 192. In the first edition of the Species Plantarum, Linn described *Poa amabilis* (=*P. plumosa* Retz) and *P. tenella* (=*P.Japonica* Thurb.) In later publications as pointed out by Otto Kuntze he revised his description of *P. tenella* and included various synonyms so that it became an aggregate including his *P. amabilis* which he also maintained separately, thus making confusion worse confounded. The *E. tenella* Beauv. ex R. & S. was based on the revised aggregate species, *P. tnella* Linn, Sp. Pl. Ed. 2 (1762) I 101, and threfore is not tenable on account of its having been interpreted as applying to the same species as the *P. amabilis* of the first edition. The earlier *E. amabilis* W. & Arn. ex Hooker & Arnott cannot interfere with the adoption of Kuntze's name for the *E. plumosa*, since it is but a synonym for *E. rubens* (Lam.) Hochst.; also, it was based on the *Poa amabilis* with 18-flowered spikelets of the systema Ed. XII, and therefore is untenable.

Eragrostis tenella (Linn) Beauv. ex. Benth., Fl. Hongk. (1861) 431; O. K., Rev. Gen. Pl. (1891) I 774. *Poa tenella* Linn, Sp. Pl. Ed. 1, (1753) I, 69; *Poa Japonica* Thunb., Fl. Jap. (1784) 31; *Er. Japonica* (Thunb.) Trin., Mem. Acad.

Petersb. Ser. XI (1831) I, 405. *E. tenella* var. *Japonica* R. & S., l. c. Bentham, l. c., restricts and uses the Linnean specific name as originally applied in the first Ed. of the Sp. Pl., that is, to designate the plant more generally known as *E. Japonica.*

Festuca elatior Linn. Meadow Fescue. A tall, coarse grass, with a large, compound panicle and spikelets about 6 lines long. Rich meadows Keweenaw Co., No. 835, August 30, 1890; Detroit, No. 835a, June 13, 1895; Monroe, No. 5812, June 2, 1921.

Festuca elatior var. *pratensis* (Huds.) A. Gray. Lower (1-3 feet) and more slender with a smaller and simple panicle and smaller, narrower spikelets. Meadows and pastures. Keweenaw Co. No. 594, September 5, 1887; Detroit, No. 594a, June 1, 1894; Rochester, No. 6955, July 9, 1924; Parkedale, No. 3475-½, June 15, 1913; Algonac, No. 3058, August 11, 1912.

Festuca nutans, Spreng. Nodding Fescue. The nodding panicle consists of a number of long, slender branches at first appressed but later spreading and often reflexed. In thin woods and around old stumps in recent clearings, usually near water. Detroit, No. 1374, June 20, 1893; Rochester, No. 1374a, July 4, 1896; Parkedale, No. 3051, August 4, 1912, and No. 3450, June 15, 1913; Amy, No. 6975, July 16, 1924.

Festuca octoflora Walt. Slender Fesccue. In sandy or sterile soils. This is an annual plant, the other species here mentioned being perennials. Orion, No. 980, May 30, 1895; Rochester, No. 980a, June 16, 1909; Marl Lake, No. 4934, June 9, 1918; Erie, No. 7000, July 30, 1924.

Festuca ovina Linn. Sheep'sFescue. Indigenous but also naturalized. In grassy fields and waste places. Very variable and has many varieties. This is a bunch grass without rhizomes. Leaves usually short and involute, not over 0:25 of a line thick. Awns shorter than the coriaceous lemmas. Keweenaw Co., No. 793, August 18, 1890; Detroit, No. 2020-½, June 6, 1907; Ypsilanti, No. 5747, May 15, 1921.

Festuca ovina var. *duriuscula* (Linn) Koch. Leaves usually flat, 0.25 to 0.50 of a line wide. Previously reported as *F. ovina* var. *duriuscula* f. *villosa*, but clearly not that. Rochester, No. 1722, July 4, 1901.

Festuca ovina var. *polyphylla* Vasey. (*F. rubra* var. *heterophylla* of the Michigan Flora, *F. occidentalis* Hook.) In this variety, the plant is more slender and the awns are longer than the membranous lemmas. Rocky woods and bluffs on the Keweenaw Peninsula. No. 531, August 15, 1887.

Festuca rubra Linn. Red Fescue. This is not a bunch grass. The base of the stem is decumbent, and there is a short rhizome or root-stock. Collected and distributed as *F. ovina* var. *duriuscula* but readily differentiated from that by its rootstock. Rochester, No. 4504, June 28, 1917.

Festuca rubra var. *pascua* Anders. A dwarf or stunted variation with a short, thick panicle. Collected and distributed as *F. ovina* var. *alpestris* Anders. Detroit, No. 793a, June 24, 1902 and No. 4509, July 6, 1917.

Festuca rubra var. *subvillosa* M. & K. In this variety the lemmas are conspicuously pubescent. Collected and distributed as *F. ovina* var. *villosa* Schrad. Algonac, No. 3641, May 24, 1914; Ypsilanti, No. 5746, May 19, 1921.

Agropyron repens (L.) Beauv. var. *subulatum* (Schreb.) Reichb. [var. *aristatum* (Doell), Volkart]. Previously reported as var. *agreste* Anders.

Agropyron repens var. *Leersianum* (Wulf. & Schreb.) Reichb. Previously reported as var. *nemorale*, Anders. The plants reported as varieties *agreste* and *nemorale* agree in all respects with the descriptions and plates of Reichenbach's varieties respectively.

Agropyron repens var. *litoreum* (Schum.) Hegi. *Agropyrum litorale* Reichb. Previously reported as variety *littoreum* Anders. but that name as used by Scribner and Smith represents *A. pungens*, a pecies not found in Michigan.

Agropyrum tenerum Vasey, var. *Novae-Angliae* (Scrib. & Sm.) Farwell. Collected at Copper Harbor in rocky woodlands. No. 1614b, August 23, 1898.

Elymus Macounii, Vasey. Woods in Keweenaw Co. No. 710, August 20, 1889. Previously reported as *E. glaucus* Buckl. (*E. Sibiricus* A. Gr. and var. *Americanus* Wats. & Coult.)

Elymus Virginicus Linn., var. *intermedius* (Vasey) Bush. *E. hirsutiglunis* Scribn. The differences in pubescence alone can scarcely give it the status of a distinct species.

Elymus striatus Willd., Sp. Ed. 4 (1897) I 470 and in Enum. Hort. Berol. (1809) 131,132; *E. Arkansanum* Scribn. & Ball, Bull, Div. Agrost. (1901) 24 p. 45 f. 19. Willdenow described the same species as Scribner & Ball, that is, the plant with glabrous or scabrous leaves, sheaths and glumes. I have found this but once in Michigan, at La Salle. No. 7165, September 17, 1924.

Elymus striatus var. *villosus* (Willd.) A. Gr. *E. villosus* Willd., Enum., l. c. Glumes, leaves, and sheaths more or less villous. Generally distributed throughout southern Michigan. Rochester, No. 5010, June 30, 1918.

ELYMUS CANADENSIS, LINN

and

ELYMUS PHILADELPHICUS, JUSLENIUS

Elymus Canadensis Linn is based on descriptions of Chenon and of Morison, as per the Species Plantarum Ed. 1 (1735)) I 83. Following my recommendations on p. 36, Vol. 10, of this journal, the Morison citation becomes the type of the species. *E. Philadelphicus* Juslenius is based on plants from Pennsylvania collected by Kalm according to the author, Cent. I Plant. (1755) and Amoen. Acad. (1759) IV 266. Since *E. Canadensis*, as commonly understood, is not found in Pennsylvania, it stands to reason that the two binomials cannot represent the same species notwithstanding Hitch-

cock's efforts (Cont. U. S. Nat. Herb. [1908] XII 123,124) to show that they are synonymous. Wiegand (Rhodora [1918] XX 87-89) follows Hitchcock and limits *E. Canadensis* to Canada, New England and northern and central New York yet paradoxically unites with it the Pennsylvanian *E. glaucifolius* Muhl. where *E. Canadensis* is not found. Bush (Amer. Mid. Nat. [1926] X, 49, 50, 76, 88) protests against the union of the two species by Hitchcock, Wiegand and others and maintains *E. glaucifolius* as a distinct species to include *E. robustus, E. brachstachys* and *E. crescendus.* It seems that Bush comes closer to being correct than the others but he should have used the earliest name for the species, *E. Philadelphicus* Juslenius, Cent. I Plant. (1755) and in Amoen. Acad. (1759) IV 266. Wiegand, l. c. 89, says "In his description Linnaeus states that the leaves were very broad and the spikelets six-flowered." I fail to find any reference to the width of the leaves in either edition of the Sp. Pl. or in the Amoen. Acad. The only reference to leaves is to color and not to width, and this of *E. Canadensis* in the 2nd ed. of the Sp. Pl.—"Folio hujus rore caerulescente, proesertim subtus abducta, quod non in pracedente" (*E. Sibirics*). This explodes the idea that the plant with conspicuously glaucous leaves is *E. Canadensis.* In *E. Canadensis* the color is dark bluish, like the color of water, while in *E. Sibirica* they are green. Juslenius describes and contrasts his *E. Philadelphicus* with *E. Canadensis* as follows: Elymus (*Philadelphicus*) spica pendula, spiculis sexfloris: inferioribus ternatis, superioribus binatis. Habitat in Pennsylvania. Kalm. *Descr.* Habitus & tota structura simillima *E. Canadensis,* sed *Spica* in hac omino apice nutat ultra basin; at in illa spica parum obliqua persistit. *Spiculae* in hac sexflorae, in illa quadriflorae, sed inprimis spiculae, & pracipue intermedia, in hac latus planum, uti *triticum,* culmo obvertit. In illa & reliquis latus angulatum scapo obvertit. Haec aristas minus rectas, & parum flexuosas, etjam dum floret, ill vero rectas habet; haec spices magis villosas, quam illa gerit. Spiculae sunt patulae, villosae, aristatae. Calyx spicula dimidio brevior.

From the above it will be seen that there is no reference to the leaves at all; that the spikes are pendulous, spikelets

6-flowered and villous, awns bent & flexuous. All these characters are characteristic also of *E. glaucifolius* which came from the same region, Pennsylvania. It is self-evident, therefore, that *E. Philadelphicus* Juslenius & *E. glaucifolius* Muhl. are one and the same. It is also seen that *E. Canadensis* has an erect spike or nearly so, 4-flowered spikelets, *awns erect* (*the Morison plant**) and florets less villous than in the other; these characters, together with the dark bluish color of the leaves, as afore mentioned, point quite strongly and unerringly to the plant recently described by Wiegand, l. c. 84-86, as *E. riparius*. It is more than likely that *E. riparius* is the true *E. Canadensis* as revised, and as it appeared in the Sp. Pl. Ed. 2, (1762) I 123. If so, this would leave the plant that commonly passes as *E. Canadensis* without a name, in so far as I am aware; that is, the plant with conspicuously glaucous leaves villous, according to Wiegand, on the upper surface.

E. Caandensis as it appeared in the Sp. Pl. 1753, is as follows:

ELYMUS spica flaccido-pendula, spiculis inferioribus ternatis; superioribus binatis. Gen. Nov. 1094.

Graman secalinum majus altissimum virginianum. Moris. Hist. 3 p. 180, s. 8. t. 10. f. 2. [should be,—t. 2. f. 5.]. Raj. suppl. 599. *Habitat* in Canada. *Kalm* . . . Variat haec spicis incurvis & pendulis. . . .

There is no specific description original with the Sp. Pl. No reference to the leaves whatever. The spikes are variable, from slightly curved to pendulous, thus including more than one species as these are at present understood. This species, two years later, was revised and divided by Juslenius, un-

---

* I wish to thank Dr. J. A. Nieuwland for his courtesy and help in looking up the Morison citation for me, which he finds is not as Linn cited it; but should be—Moris. Hist. 3, p. 180, s. 8. t. 2. f. 5. He informs me that the awns of the spike are practically straight, not appreciably curved. This indicates that Linn and Juslenius accepted the Morison citation as the type of *E. Canadensis* Linn. which undoubtedly is *E. riparius* Wieg.

doubtedly with the approval of Linn, who accepted the species as revised for the 2nd. Ed. of the Sp. Pl. This early revision definitely characterizes both *E. Philadelphicus* and *E. Canadensis*, settles the status of each, and cannot now be disturbed. The *E. Canadensis* of Wiegand, excluding *E. glaucifolius*, probably is but a villous leaved form of *E. Philadelphicus* found in its northern range as *E. robustus* is usually but a green leaved form found in its western range. As to the latter, Wiegand, l. c. 89, unites *E. robustus* and *E. brachystachys* under the former name and says: "The type material of *E. robustus* (*Pammel* Iowa). . . has the lemmas entirely glabrous." I can not and do not agree with Wiegand on two accounts: (1) because the authors described the lemmas as scabrous or pubescent and (2) because they mentioned neither collectors nor collections. How anyone can designate as the type of a species a plant not mentioned by the authors and with a character positively excluding it is beyond my comprehension. If a single specimen is subsequently to be designated as a "type" it at least should be one that agrees with the original description.

The species would be as follows:

Elymus Canadensis Linn, Sp. Pl. Ed. 1 (1753) I 83 as to the Morison plant and as amended by Juslenius in syn. in Cent. I. Plant (1755) and in Amoen. Acad. (1759) IV 266; L. J. Chenon in Gen. Nov. in Amoen, Acad. (1756) III 20; Linn. Sp. Pl. ed. 2 (1762) I 123; Torrey Fl. U. S. (1824) I 137; *E. riparius* Wieg., l. c. 84, 85.

Awns straight, leaves green. Has not been observed in Michigan.

Elymus Philadelphicus Juslenius, ll. cc.; *E. glaucifolius* Muhl. ex. Wild., Hort. Berol. (1809) 131. *E. Canadensis* var. *glaucifolius* (Muhl.) Torr., Fl. U. S. (1824) I 137. Spikes long (8-12 inches) and flexuous, awns curved outward, leaves broad and flat, conspicuously glauceous, rough (not villous) especially above, often smooth beneath toward the base. Detroit, No. 1556, September 17, 1896; Rochester, No. 1556a, September 6, 1909. In the herbarium of Parke, Davis & Co.,

there is a sheet of this collected in August, 1879, by Dr. H. H. Rusby at Delaware Water Gap, Pennsylvania.

E. Philadelphicus var. *hirsutus*, N. Var. *E. Canadensis* Linn ex Wieg., l. c. 87 in large part (exclude syn.) Upper surface of leaves villous. Not observed in Michigan.

E. Philadelpicus var. *pendulus* (Eaton & Wright) N. Comb. *E. Canadensis* var. *pendulus* Eaton & Wright, N. Amer. Bot. Ed. 8 (1840) 232; *E. Canadensis* f. *crescendus* Ramaley, Minn. Bot. Studies (1894) I, 114. Evidently only a green (non-glaucous) phase of the typical form of the species. Detroit (Redford), No. 4753b, October 14, 1917 and No. 7249, October 8, 1924; Ann Arbor, No. 7042a, August 20, 1924. In the herbarium of Parke, Davis & Co. are two sheets of this. One from Franklin, N. J., where collected by Dr. H. H. Rusby in 1878. One from New York without locality, collected in 1881 by O. E. Pearce.

E. Philadelphicus var. *robustus* (Scribn. & Sm.) N. Comb. *E. Canadensis* var. *robustus* (Scribn. & Sm.) MacKenzie & Bush, Man. Fl. Jackson Co., Mo., (1902) 38; Farwell, Ann. Rpt. Mich. Acad. Sci. (1920) XXI 357; *E. robustus* var. *vestitus* Wieg., l. c. 90; *E. glaucefolius crescendus* (Ramaley) Bush, Amer. Mid. Nat. (1926) X 83; *E. robustus* Scribn. & Sm., Bull. Div. Agrost. (1897) 4 p. 37. The leaves usually are green and more or less involute, spikes short, thick, erect, short exserted or more or less included, lemmas, scabrous or pubescent. Marquette*, No. 1619-½, Aug. 30, 1898; Detroit, No. 1409, July 8, 1899; Rochester*, No. 1619b, September 6, 1909. Monroe Piers*, No. 2184-½, August 20, 1910; Oxford, No. 6678, August 8, 1923; Imlay City, Nos. 6685 and 6686, August 15, 1923; Geddes, No. 7057, August 20, 1924; Monroe Piers, No. 7066, August 27, 1924; Squirrel Island, Ontario, Canada, No. 7117, September 3, 1924.

E. Philadelphicus var. *brachystachys* (Scribn. & Ball) N. Comb. *E. brachystachys*, Scribn. & Ball, Bull, Div. Agrost.

* Early determination; specimens not at present available for re-examinations which might place them in other categories.

(1901) 24 p. 47. E. *Canadensis* var. *brachystachys* (Scribn. & Ball) Farwell, Ann. Rpt. Mich. Acad. Sci. (1920) XXI 357. *E. robustus* Scribn. & Sm. in Wieg., l. c. 89; *E. glaucifolius robustus* (Scribn. & Sm.) Bush., l. c. 86, 87. Similar to var. *robustus* but the lemmas are glabrous or rarely, sparsely and minutely strigillose. Detroit, No. 1409, August 11, 1893; Orion*, No. 1409a, August 29, 1895; Island Lake*, No. 1929-½, July 16, 1905; Rochester*, No. 2109-½, August 15, 1909; Ann Arbor, No. 7042, August 20, 1924; Denton, No. 7131, September 10, 1924; Dearborn, No. 7508, August 5, 1925.

Asperella Hystrix (Linn) Humb. var. *Bigeloviana* Fernald. Porcupine Grass. In the herbarium of Parke, Davis & Co., is a sheet of this variety collected at East Greenwich, N. Y., in 1867, by Dr. Asa Fitch.

Koeleria cristata (Linn) Pers. This grass is found in dry, usually sandy soil. Bloomfield, No. 4609, September 16, 1817; Ypsilanti, No. 5240, June 15, 1919; Algonac, No. 7421, June 17, 1925.

Reboulea obtusata (Mx.) A. Gr. var. *lobata* (Trin.) Farwell. The panicle is much contracted, spike-like and lobed. In gravelly soil Copper Harbor, No. 7748-½, August 5, 1926; Lake Linden, No. 7761-½, August 8, 1926.

Eleusine Indica Gaertn. Yard Grass. Waste places and in old yards. Monroe, No. 6721, August 22, 1923; Detroit, No. 7635a, September 10, 1925.

Anthoxanthum odoratum Linn. Sweet Vernal Grass. Usually in meadows and pastures. Detroit, No. 5033m, July 6, 1918; Ypsilanti, No. 5858, June 12, 1921; Clifton, No. 7770-½, August 11, 1926.

---

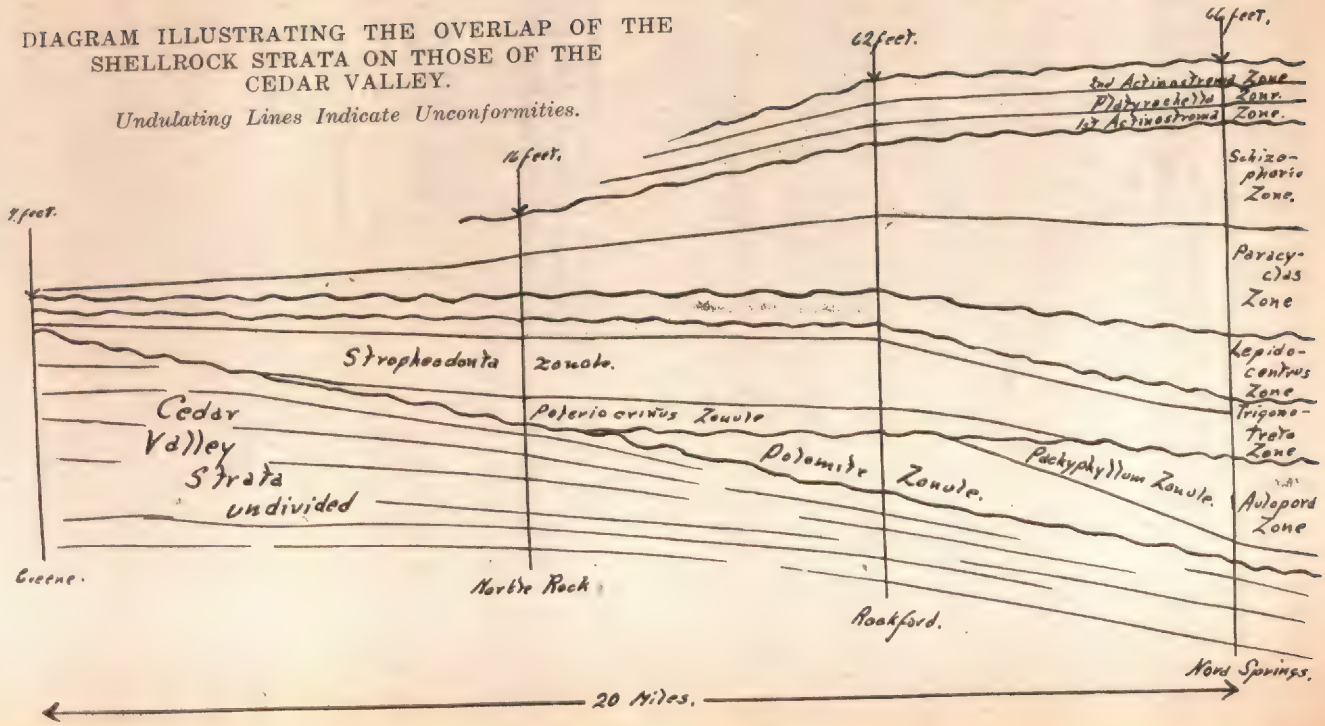
* Early determination; specimens not at present available for re-examinations which might place them in other categories.

Department of Botany,
Parke, Davis & Co.,
Detroit, Michigan.

(Belanski on Shellrock Stage)

DIAGRAM ILLUSTRATING THE OVERLAP OF THE SHELLROCK STRATA ON THOSE OF THE CEDAR VALLEY.

Undulating Lines Indicate Unconformities.



THE SHELLROCK STAGE OF THE DEVONIAN OF IOWA

By C. H. BELANSKI

I. INTRODUCTION

A—NATURE OF THE STUDY

During the past ten years the author has done considerable collecting in Devonian strata of Floyd and Cerro Gordo counties in the north-central part of Iowa. Strata of various ages are exposed in these two counties, virtually all of which belong to the Upper Devonian. It was early noted that the fossils collected from these strata, then referred to the Cedar Valley Stage, were widely different from fossils found in that stage at Waverly, Waterloo, Iowa City and other points farther south where the typical Cedar Valley beds are exposed. Furthermore, attempts to correlate the sections of those beds, as published by various authors, with the exposures in Floyd and Cerro Gordo counties were far from satisfactory. As a result of these discrepancies work was started in 1920 to find the true relationships of these northern strata to those exposed in the central and southern portions of the Iowa Devonian belt.

Every available outcrop in the region described has been sectioned and the fossils obtained have been carefully separated and catalogued according to the members and localities from which they came. During the progress of this work over 100 sections have been made and upward of 30,000 fossils collected. Detailed maps and tabular section charts have been made of all of the territory surveyed, which includes the western half of Floyd County, the eastern portion of Cerro Gordo and the northern portion of Butler County. Work has been carried southward and eastward to the points where the beds under discussion are no longer exposed, and although the study is by no means complete, it has reached a point where publication of the conclusions and pertinent

data is not only justified, but should prove of value to paleontologists and stratigraphers.

Although this is but a preliminary paper it nevertheless describes the beds fully enough that their relationships can be understood and possibilities of later confusion avoided. Unfortunately, though some work has been done along Lime Creek west of the Floyd County line, the exact relationships of the zones and zonules in the lower part of the sections in the Portland and Mason City districts have not been fully determined. The substages can be traced more or less continuously throughout this area, but the beds exhibit such sharp and rapid lithologic changes that it is unwise to delineate the minor members until further field work determines their relationships to each other and to the eastern sections.

The territory yet to be studied consists of the northern portion of Cerro Gordo County and a portion of southern Worth County. Perhaps the strata under consideration also are exposed in the south-western corner of Mitchell County. The beds of the Shellrock stage exposed along Lime Creek and its tributaries will form the second, and probably the final report on the stratigraphy of the Shellrock stage, for which it is hoped the field work will be completed by the end of 1927.

B—PREVIOUS GEOLOGICAL WORK

Previous detailed geological work done in the present area has been slight. Owen[1] makes reference to the "beds of the Shellrock Valley." Hall[2] devotes a chapter to the geology of Howard, Mitchell, Chickasaw, and Floyd counties in which some of the beds of the present area are described and correlated with divisions of the New York Devonian. Hall and Whitfield's paper[3] again makes reference to the beds of this stage and a section from an exposure near Rockford is given, but the strata are again referred to the Chemung. McGee

1 Rept. of Geol. Wis. Minn. pt. I, p. 78; 1852.
2 Geol. of Iowa. Pt. I; 1858.
3 23rd Ann. Rept. N. Y. State Cab.; 1872.

gives a short description[4] of the beds of the Mason City district. Calvin[5] devotes 16 pages to the description of the "Cedar Valley" rocks of Cerro Gordo County and also gives a general section of the beds exposed at Nora Springs. He places all of these strata in one substage, and on the basis of the heavy stromatoporoidal beds shown at Mason City and Nora Springs correlates these limestones with similar ones in the Cedar Valley stage of Johnson and Black Hawk counties. To the strata shown in Floyd and Cerro Gordo counties he applies the term Mason City substage. Arey[6] in his report of Butler county mentions exposures of "Cedar Valley" strata along Coldwater Creek southwest of Greene, but does not note the occurrence of the Shellrock strata at these points.

In 1913[7] Thomas named the Nora Limestone from strata exposed in western Floyd County but published no definition. Fenton[8] refers to the "Nora Formation" and in the same map uses the name "Shellrock"as a geologic unit, making it a substage of the Cedar Valley stage but giving no sections or definitions. In 1924 the same author[9] again refers to these strata in a similar manner. Thomas[10] first used the name Shellrock in the sense of a stage name, including his Nora Limestone and the Mason City substage of Calvin as substages, and suggesting other additional ones. Here again no sections were given nor definitions made.

C—SHELLROCK STAGE

In northern Butler, western Floyd, northeastern Cerro Gordo, and southern Worth counties there is developed a group of strata consisting largely of shaly limestones and dolomites with occasional shale layers and more or less lithographic limestones. These beds form a narrow belt extend-

4 Rept. 10th Census, Vol. X,, pp. 261-263.
5 Iowa Geol. Surv. Vol. 7; 1897.
6 Iowa Geol. Surv. Vol 20, pp. 30-31; 1910.
7 Science n. s. Vol. 37, p. 459; 1913.
8. Am. Jour. Sci. 4th ser., Vol. 48, pp. 357-358; 1919.
9 Cont. Mus. Geol. Univ. Mich. Vol. 1, map explanation, frontispiece; 1924.
10 Iowa Geol. Surv. Vol. 29, pp. 411-412; 1924.

ing along the Shellrock River and its tributary streams and never exceeding twenty miles in east-west width. They lie above the beds of the Cedar Valley stage and below the blue shales of the Juniper Hill Shale[11], being separated from both of these formations by sharp, persistent, unconformities. These beds are held to constitute a new and heretofore undescribed stage of the upper Devonian of Iowa, and because of their development along the Shellrock River, the name *Shellrock Stage* is here proposed for them. They attain their greatest thickness along that stream between Nora Springs and Rockford, two towns near the western border of Floyd County. Exposures of the various substages of the Shellrock are more or less continuously shown along the Shellrock from Greene, in northern Butler County, to Manly, in southeastern Worth County. Along Lime Creek these same beds are exposed from Rockford, at the mouth of that stream, to Fertile in southern Worth County. Still other exposures lie along Willow creek in Mason City, along Flood creek from Rudd southward, and along the Coldwater creek south and west of Greene. This paper deals only with those strata shown along the Shellrock river and Flood creek in Floyd, Butler and eastern Cerro Gordo Counties, an area some 30 miles in length and 12 in width.

The Shellrock beds of this area apparently were deposited close to the eastern and southern margins of the sea, as is indicated by their rapid thinning to the south and east; while the numerous unconformities and erosion planes show that during the period of deposition there was much disturbance of the sea basin. In the western areas, however, the erosional periods were much less marked and the beds themselves are more stable in character.

The lithological character of the different units or zones of this stage, in the area discussed, is extremely variable. No one zone holds its thickness for any great distance and some of the faunules present in one zone at one locality may be absent or replaced by different faunules at another set of localities where the same zone is exposed. The lithologic and

11 Thomas, Iowa Geol. Surv. Vol 30, footnote p. 116; 1925.

faunal changes of the strata are further complicated by the amount of erosion which some of the beds have undergone, five distinct unconformities being shown in Floyd County alone.

Northward and westward all of the beds of the Shellrock stage become markedly dolomitic, forming part of a broad belt running roughly east and west along the northern border of Iowa in which all of the Devonian strata become more or less dolomitized. This belt is first noted at Cresco, in Howard County, whence it extends westward into Mitchell and northern Chickasaw counties, across northern Floyd and finally ends in western Cerro Gordo County.

D—TERMINOLOGY

The term *zone,* as here used refers to a particular group of rocks, not necessarily retaining the same lithologic character wherever exposed but marked by a species or group of species which are especially characteristic to them. The term *zonule* refers to a subdivision of a zone lithologically distinct from other zonules of the zone. *Faunule* is held to refer to an association of species forming a more or less distinct biologic group, the term therefore having only biologic significance.

A *zonule* is marked by a *faunule* found only in that zonule. Neither of these necessarily need be found at all points where the horizon is exposed, but may be replaced by a different zonule carrying a different faunule, or they may be entirely absent in the zone.

In the Trigonotreta zone, for example, there are in the Nora Springs phase four members or zonules each bearing its own distinct faunule but all tied together but the abundant occurrence of *Trigonotreta shellrockensis* n. s. One of the members of this zone is the Decadocrinus zonule, a series of thin-bedded magnesian limestones carrying a faunule of crinoids and molluscs. In the Rockford phase this same horizon is occupied by the Stropheodonta zonule, a series of heavy bedded, shaly limestone carrying a faunule of brachiopods, corals and molluscs.

Such rapid lithologic and faunal changes are the rule rather than the exception in Shellrock strata; no great number of the zonules holding their character for more than five miles.

II—STRATIGRAPHY

A—GENERAL

As has been said, the Shellrock stage lies between the upper Cedar Valley limestones and the shales of the Juniper Hill formation. It consists largely of limestones and dolomites with several shale beds which are more or less persistent, and may be divided into three substages, which contain several zones, and a still larger number of zonules.[12]

Because of the marked areal variation of the strata, it has been found necessary to describe the Shellrock stage according to its local aspects or phases. These, however, are complicated, and become intelligible only when compared with a generalized standard section; which also becomes necessary for reference in future descriptions of fossils. The discussion of stratigraphy therefore begins with the general section, which progresses from top to bottom of the beds described. In the section the capitalized letters indicate substages while Roman numerals are used to indicate zones. Arabic numerals indicate the zonule horizon while the letter

---

12 In the present paper zones and zonules are designated only by the generic name of the most diagnostic fossil. In the final paper these beds will be designated by the specific name as well; thus the Camarophoria zonule of the present paper will become the Camarophoria paupera zonule etc. Because of the large number of new species it is impossible at present to give full name for these beds. Furthermore it will very likely be necessary to change certain of the names, particularly those of the Nora substage. As will be noted the bulk of the fauna of this substage is stromatoporoidal and since virtually nothing is now known of the specific relations of these fossils, such changes must be deferred until these fossils are described. This also holds true for the terms 1st. and 2nd. Actinostroma zones as used in the present paper. The number of zonules, particularly in the Nora substage, will be materially increased by further field work. Thus it is known that the upper Actinostroma zone, which in this paper appears to hold but one basic member, consists of three members in the undescribed western phases.—C. H. B.

immediately following the numeral indicates the particular zonule in that horizon. Thus it will be seen that there are sometimes several distinct zonules present at the same horizon but at different points.

C.—THE NORA SUBSTAGE

Hard, white, stromatoporoidal limestone, magnesian shale, shaly limestone, and (in the northern phases) dolomites, varying in thickness from 6 to 20 feet. The substage is best developed near the town of Rockford; it thins rapidly toward its eastern and southern borders, and is present only as remnants from Rudd southward to Marble Rock. At Greene it appears to be absent.

The type exposure of this substage is an abandoned quarry near Nora Junction, in the northeast quarter of the northeast quarter of section 18, T. 96 N., R. XVIII W. It was designated by A. O. Thomas when he named the Nora Limestone[13] but no section was given. In another paper Thomas published a photograph of an exposure near Rockford, though he still refrained from giving a section.[14] The best exposures, as has been said lie near the town of Rockford.

VIII.—SECOND ACTINOSTROMA ZONE

This zone, throughout the area described, is composed largely of shale or argillaceous limestone so crowded with stromatoporoids that it has the appearance of a true limestone. It is typically developed along the Shellrock River from Rockford to Nora Springs, its upper surface being deeply eroded and generally covered by the basal blue shales of the Juniper Hill formation. Its maximum thickness in Floyd County (at Rockford) is 84 inches.

24a—PSEUDOTECTUS ZONULE

This is the typical phase development of the second Actinostroma zone in the central Shellrock region. The predominant fossils are closely crowded colonies of several species of

---

13 Science, n. s., Vol. 39, p. 459; 1913.

14 Iowa Geol. Surv. Vol. 29, fig. 62, p. 411; 1924.

Actinostroma. Throughout the shale matrix there are abundant brachiopods, and echinoderms, the most common of these being a fine-ribbed *Atrypa*, an undescribed *Pseudotectus*, *Euomphalus planodiscus* ? Hall and several other small gastropods and cephalopods.

24b—STROMATOPORA ZONULE

This is the northward extension of the preceeding member, and is shown along the Shellrock River from Nora Springs northward to Rock Falls. It is more calcareous than the zonule just described and carries a very different fauna. The laminar stromatoporoids are still abundant with the genus *Actinostroma* persisting. With these, and occasionally composing the bulk of the fauna, are numerous laminar colonies of *Stromatopora*. Small fossils are apparently limited to the fine-ribbed *Atrypa* and occasionally a small *Athyris*. The maximum thickness in the Reed Creek phase is 90 inches.

VII.—PLATYRACHELLA ZONE

This member is well developed over all of western Floyd County, where it is normally composed of three subzones. It is a true shale stratum although the central member is more calcareous than the others. In the area described the various members are generally conformable, though in the more western and northern phases there is evidence of erosion between certain of the strata.

23a—UNNAMED ZONULE

This member is well developed over all of western Floyd River from Rockford north to the Floyd-Cerro Gordo County line. It is a magnesian shale, generally barren, but at Rockford contains casts of a undetermined species of *Platyrachella*. At this point it also reaches its maximum thickness, 75 inches. This shale becomes more indurated in the northern phases, in places being represented by firm, brown dolomite.

22a—SYRINGOPORA ZONULE

This zonule is normally composed of shaly, thin-bedded limestone some 18 inches thick, containing thousands of obscure fucoidal markings, together with small crinoid stems,

occasional molluscs and rugose corals, and rare brachiopods. The zonule is typically developed at Rockford, where its upper surface is covered by the tubes of a slender, undescribed species of *Syringopora*. It can be traced up the Shellrock River nearly to the Baumgardner phase, where it feathers out. North of Nora Springs the same stratum reappears as the

22b—PTYCHOPHYLLUM ZONULE

This member differs from the preceding chiefly in the absence of the *Syringopora* and in a much greater abundance of brachiopods. Lithologically it is more shaly and more unstable than its southern equivalent, and shows a tendency to intergrade with the shale stratum below. Northward from the Keidle Bluff phase it is represented by barren dolomite which is separated with difficulty from the beds above and below.

21a—SCHUCHERTELLA ZONULE

This name is used for the shale stratum below the Syringopora zonule at Rockford. Like the unnamed zonule at the top of the zone, it is highly magnesian; yet it carries an abundance of well preserved fossils; brachiopods, corals and echinoderms being common. The most diagnostic species being *Platyrachrella ballardi* n. s. and an undescribed *Schuchertella*. Northward along the Shellrock the member can be traced to the Baumgardner phase, although in this distance it loses its faunule. Because of this, and also because of the lithologic resemblance to the unnamed zonule of this zone, it follows that from the point of disappearance of the Syringopora zonule to the reappearance of the Ptychophyllum zonule, the upper and lower shale members of the Platyrachella zone can not be separated—as is shown by the Nora Springs phase. North of Nora Springs, in the Reed Creek phase, the Schuchertella zonule again becomes fossiliferous, specimens of *Platyrachella ballardi* n. s. found here attaining nearly twice the size of those from Rockford. Other brachiopods appear to be absent, although rugose corals are common. All of the fossils are casts. In the phases north of this, fossils are rare.

VI.—FIRST ACTINOSTROMA ZONE

Unlike the second Actinostroma zone, this is primarily a limestone member, for though its southern phases are composed largely of laminar stromatoporoids, the matrix is a hard gray limestone. Along the Shellrock River in Floyd County it is composed of but one unit, the upper surface of which is considerably eroded. Throughout this area it forms the base of the substage and is separated from the substage below by a distinct unconformity. In the phases shown north of Nora Springs, the basal Expansum zonule is reenforced by two additional, superimposed zonules.

20a—UNNAMED ZONULE

At the point of its appearance, in the Sherman Bluff phase, this zonule is composed of soft, brown, crystalline, barren dolomite, separated from the subjacent beds by a strong bedding plane, which to the westward becomes an unconformity. In the Rock Falls phase this zonule is represented by nearly four feet of hard, blue-gray limestone containing numerous spheroidal stromatoporoids as well as thousands of slender-stemmed idiostromids. The generic or specific relations of the stromatoporoids being unknown, they afford no name for the rocks which contain them.

19a—MACGEEA ZONULE

This member appears as remnants a short distance west of the Floyd County line, increasing northward until in the Rock Falls phase its thickness is over 6 feet. Its fauna is best shown in the Reed Creek phase, where the member is charged with abundant specimens of tabulate and rugose corals, including two or three undescribed forms of *Macgeea*. Other fossils are rare. In the Reed Creek phase the member is a hard, brown limestone which northward becomes a firm, fine-grained, unfossiliferous dolomite scarcely to be distinguished from the beds above and below. In the Rock Falls phase it is sparingly fossiliferous, and like the zonule above, is composed of hard, fine-grained, blue-gray limestone.

18a—EXPANSUM ZONULE

This name is given to the one bed composing the first Actinostroma zone in the central Shellrock region [Rockford

to Nora Springs), where it is composed of hard, blue-gray limestone crowded with colonies of laminar stromatoporoids, the most common of which is *Actinostroma expansum* (H. & W.) With these are several species of *Cyathophyllum* and *Phillipsastrea*. Other fossils are uncommon.

18b—PRISMATOPHYLLUM ZONULE

This name is applied to beds occupying the same horizon as the Expansum zonule but developed in the eastern and southern portions of the Shellrock area. It is best shown along Flood Creek near Rudd, where it is composed of soft, yellow, argillaceous limestone carrying numerous laminar stromatoporoids but characterized mainly by its abundant brachiopods and corals; *Prismatophyllum oweni* n. s. being especially common. Some forty species of corals and brachiopods are known from this zonule, very few of which occur in the Expansum zonule. The same, or a very similar faunule, is found north of Marble Rock and throughout Ulster township.

(In the phases to the north of Nora Springs, the Expansum zonule again changes. This is specially marked in the Reed Creek phase, where the member is composed of hard, brown limestone bearing spheroidal stromatoporoids, the laminar forms being uncommon to rare. A flattened form of *Trigonotreta shellrockensis* n. s. is also common here, along with other brachiopods not found in either of the equivalent zonules to the south and east. Northward, this, like the zonules above, becomes dolomitized and loses its faunule. It suffers a considerable decrease in thickness but can be traced to the Rock Falls phase where it once more becomes a limestone bearing spheroidal stromatroroids. For this facies a new name will later be proposed.)

B—ROCK GROVE SUBSTAGE

Magnesian shale, shaly limestone, and impure dolomite, typically developed at Nora Springs, but present as a whole or in part at all phases found in Floyd and eastern Cerro Gordo counties; thinning rapidly in all directions from Nora Springs. In the Mason City district it apparently is repre-

sented by only the lower (Gomphoceras) zonule of the Paracyclas zone, the superjacent zonules having been eroded away. To the south and east of Nora Springs this erosion plane again becomes more marked, cutting into successively lower and lower beds. Where the substage is typically developed the top of the upper (Schizophoria) zone is separated from the overlying Nora substage by a sharp unconformity, while the base of the substage is set off sharply from the subjacent beds by another, but less marked, erosion plane.

The term Rock Grove is given to this substage because of its great development in Rock Grove township of Floyd County. The type exposure is located on the eastern (left) bank of the Shellrock River a short distance southeast of Nora Springs, in the southwest quarter of the northeast quarter of section 17, T. 96 N., R. XVIII W.

V.—SCHIZOPHORIA ZONE

This zone is well developed throughout the western portion of Floyd County, north of Rockford. It normally is composed of earthy dolomites and magnesian and calcareous shales with some shaly limestones, attaining its maximum thickness (12 feet) at Nora Springs. It is separated from the overlying Nora substage by a strong unconformity which is well shown at various points near Rockford, Nora Springs and Rudd. In the Bjorgason phase, north of Nora Springs, the uppermost member of the zone is eroded away and in less than a mile to the north of this, the shaly beds below, here comprising the balance of the zone, also disappear.

17a—STROBILOCYSTITES ZONULE

This name is given to a soft, argillaceous limestone developed below the Nora substage on the eastern side of the Shellrock River, southeast of Rockford, and noted only in the Rockford phase. It apparently has no direct time equivalent in any of the other members of this zone. The maximum thickness is 18 inches. It is very fossiliferous, the most common form being a species of *Strobilocystites* closely allied to *S. calvini* White, with which are associated many other echinoderms and several brachiopods. Its closest faunal

relationships are with the Camaraphoria faunule, at the top of the Mason City substage. The absence of the Strobilocystites zonule at other points north and east of Rockford apparently is due to erosion.

16a—ULSTERENSIS ZONULE

This is a group of heavy-bedded, earthy dolomites, which are well exposed along the Shellrock from Nora Springs to Rockford, normally forming the top of the substage. Their contact with the Nora substage is sharply unconformable. The zonule attains its maximum thickness (72 inches) at Nora Springs. At Rudd, the upper, more fossiliferous portion is eroded away and the member is less than 20 inches thick, while it apparently is absent at Marble Rock. Fossils are abundant, but they consist entirely of casts, which, however, are well preserved. The most common form is *Spirifer ulsterensis* n. sp., which includes more than half of the total number of specimens found. *Schizophoria floydensis* n. sp. is also common as well as several other brachiopods. Corals and echinoderms are rare.

16b—CONULARIA ZONULE

This name is applied to beds equivalent to the Ulsterensis zonule and of much the same lithologic character, developed along the Shellrock River north of Nora Springs. The bedding is thinner and the member itself thins to the northward, finally disappearing in the Bjorgason phase. The abundant brachiopods of the Ulsterensis faunule are replaced by numerous molluscs and fish, with an undetermined *Conularia* the diagnostic fossil.

15a—ATRYPA ZONULE

Magnesian shales which underlie the Conularia and Ulsterensis zonules, in places intergrading with the latter, though not with the Conularia beds, and attaining a maximum thickness of 90 inches at Nora Springs. The only fossils noted are *Spirifer ulsterensis* n. sp. and a coarse-ribbed *Atrypa*, both of which are found in the Ulsterensis zonule. This zonule has not been noted south of Marble Rock and in

the northern part of the Sherman Bluff phase has been removed by erosion. Although faunally identical with the Ulsterensis faunule, yet the lithologic difference of these two would seem to warrant separation of the two zonules.

14a—LOXONEMA ZONULE

This member is typically developed along Flood creek, near Rudd, where it is composed of 18 inches of soft shaly limestone. It, or an equivalent zonule, is seen again along the stream at Rockford, but apparently is lacking in the Baumgardner and Nora Springs phases and in most localities south of Rockford. The most common fossil is *Schizophoria floydensis* n. s. the valves of which occur in thousands. The *Loxonema* from which the zonule is named is a small form closely resembling *Loxonema pulchra* (F. & F.) from the Owen substage, at the top of the Iowa Devonian. This species, and several other gastropods are very abundant.

14b—CRANIA ZONULE

This occupies the same horizon as the Loxonema zonule but is a much more shaly facies, best developed in the central part of Ulster township with a maximum thickness of 20 inches. Faunally there is a marked difference in the two; the Crania zonule contains very few molluscs but hosts of bryozoans, brachiopods, and echinoderms. The diagnostic fossil is a peculiar *Crania*, the separated valves of which are abundant.

IV.—PARACYCLAS ZONE

This, like the overlying zone, is well developed in western Floyd County. It normally is composed of shaly limestone through its entire thickness. The upper beds apparently are conformable with the Schizophoria zone above, where that member is present; its base is set off from the Mason City substage below by a well marked unconformity, as well as by distinct lithologic and faunal changes. It is the most widespread zone of the substage, being found with practically its entire thickness at all exposures studied.

13a—PRODUCTELLA ZONULE

A series of irregularly bedded, shaly limestone, best developed along Flood creek near Rudd, where they are about 40 inches thick. It is crowded with fucoidal and molluscan casts, while the upper ten inches bear an undetermined species of *Productella*, the shells of which are extremely abundant. This or an equivalent zonule, bearing the molluscs but not the *Productella* is shown along the Shellrock from Rockford to the Baumgardner phase. The zonule is apparently not developed in the vicinity of Nora Springs.

12a—PTERINEA ZONULE

This zonule consists of a series of firm to hard, shaly, semimagnesian limestones and buff colored dolomites typically developed at Nora Springs with a thickness of 45 inches. It appears more or less continuously from Greene to Sherman Bluff, where it merges with the zonule below, Wherever shown it is nearly barren, a single cast of *Pterinea* having been found in the Nora Springs phase and other poorly preserved molluscs near Greene.

11—GOMPHOCERAS ZONULE

A series of thin-bedded shaly limestones with regular shale partings which form what perhaps is the most widespread and stable member of the substage, extending from Greene northward to the Bjorgason phase with practically no lithologic or faunal change. Northward from the Bjorgason phase it merges with the Pterinea zonule and, in common with the other strata of these phases, becomes heavily dolomitized. Its thickness increases to nearly 10 feet and the beds become much heavier. In the Mason City sections the Gomphoceras zonule is the only member of the Rock Grove substage, being represented by from 10 to 12 feet of hard, blue-gray, sublithographic limestone. In Floyd County the faunule of this unit is largely molluscan, consisting of several species of pelecypods, a large, rapidly expanding form of *Gomphoceras*, beside fish and crustacean (?) remains. At Nora Springs it has a thickness of 54 inches, the greatest shown in Floyd County.

A—MASON CITY SUBSTAGE

Shaly, blue-gray limestone, impure dolomites, occasional layers of shale, and some lithographic limestones; typically developed at Mason City, where virtually all of the substage consists of heavy-bedded dolomite. The zones and zonules, however, are best shown in western Floyd County, where the dolomitization is less marked and fossils better preserved. Southward and eastward from Mason City the substage thins rapidly, though it is represented in all of the phases in western Floyd County. Its upper surface is undulating, and generally marked by iron-filled cavities, the unconformity being most marked in the northern phases. The basal beds are separated from the subjacent Cedar Valley stage by an unconformity which is most strongly marked in the southern phases, in which a strong overlap of the upper zones is shown, thus recording the progressive encroachment of the early Shellrock sea. At Marble Rock and Greene the Stereocrinus and Stropheodonta zonules of the Trigonotreta zone form the base of the substage, while from Rockford northward the Dolomite zonule of the Aulopora zone forms the base. The type exposure of this substage lies in the western part of Nora Springs along the eastern (left) bank of the Shellrock River in the southeast quarter of section 7, T. 96 N., R. XVIII W.

The term Mason City substage was originally used by Calvin[15] and was applied by him to all of the "Cedar Valley" beds shown in Cerro Gordo and western Floyd counties beneath his "Lime Creek Shale." Later this name was amended to Mason City dolomite[16] a modification which may well be abandoned, since a great part of the substage is not dolomite.

Unfortunately, the stromatoporoidal beds of Calvin's Mason City sections, which he thought were identical with beds exposed near water level along the Shellrock west of Nora Springs, really belong to the lower part of Thomas' "Nora Limestone," and form the First Actinostroma zone of this paper; while the calcilutites and heavy-bedded limestones be-

15 Iowa Geol. Surv. Vol. 7, p. 144; 1897.
16 Iowa Geol. Surv. Vol. 29, p. 412; 1924.

neath the stromatoporoid beds at Mason City are equivalent to the lower part of the Paracyclas zone, which in turn forms a part of the Rock Grove substage as here defined. This leaves only the lower, heavily dolomitized beds of the Mason City section to which the term Mason City substage can now be applied. No type exposure was indicated by Calvin or Thomas; it is here located at Nora Springs because the zones there are more distinct and their faunas more readily determined than at Mason City. With the exception of one thin layer of shale at "Parker's Mill" in Mason City [17] the beds of this substage there have proved to be barren.

III.—LEPIDOCENTRUS ZONE

The Lepidocentrus zone is typically developed along the Shellrock River at Nora Springs, where it is composed of impure limestone the texture of which varies considerably. It forms the uppermost zone of the Mason City substage throughout all of western Floyd County and its upper surface always bears evidence of a considerable erosion break shortly following its deposition.

10a—CAMAROPHORIA ZONULE

This zonule is typical developed at Nora Springs, where it is composed of some 18 inches of soft, yellow-brown, argillaceous limestone. It extends southward some two miles, gradually changing its character until at the Rock Grove Mill it is represented by the Cladopora zonule [10b]. The Camarophoria zonule reappears at Rockford, to again be replaced by the Cladopora zonule from Marble Rock to Greene. Southwest of Greene, in section 1 of Benezette township, it again appears along the southern slopes of Coldwater creek. Northward from Nora Springs the strata retain the Camarophoria faunule, but in common with the other beds of these phases becomes heavily dolomitized and, from the Reed Creek phase northward, hardly can be separated from sub- and superjacent strata.

---

17. The mill is now gone but the name remains. The locality lies on eastern (right) bank of Willow creek just south of the State Street bridge.

The Camarophoria faunule is very rich, containing not less than 100 species. The most common forms are *Camarophoria paupera* n. sp., *Lepidocentrus thomasi* n. sp. *Strobilocystites schucherti* Thomas, *Stropheodonta cicatricosa* n. sp., *Cyathophyllum floydensis* n. sp., *Phillipsastrea minutissima* (Webster) and *Hypothyridina magister* n. sp. The echinoid material is exceptionally interesting.

10b—CLADOPORA ZONULE

This name is given to beds equivalent to the Camarophoria zonule but which are more calcareous and which are shown in the southern and eastern phases. The zonule first becomes marked in character at the Rock Grove Mill and continues southward nearly to Rockford, where the Camarophoria zonule is again shown. South of Rockford the Cladopora zonule reappears, continuing with but little change southward to the exposures in section 14, Coldwater township, southwest of Greene. The same, or closely related zonule is found along Flood creek from Rudd to Roseville. The average thickness of this member is 12 inches, thinning to 9 inches at Greene. Its faunule is rich in specimens but poor in species; an undetermined species of *Cladopora* being common as well as large forms of "Atrypa reticularis."

9a—ATHYRIS ZONULE

A series of hard, blue gray to buff, somewhat shaly limestones which lie below the Camarophoria zonule at Nora Springs. The zonule extends southward about a mile from that point, where it feathers out. It is well developed north of Nora Springs where, like the Camarophoria zonule, it becomes dolomitized and almost unrecognisable. It contains abundant laminar and hemispherical stromatoporoids belonging largely to the genus *Actinostroma*. With these are associated several species of brachiopods most of which occur also in the Camarophoria zonule; their numbers are small, however, when compared with those of the Camarophoria zonule. The greatest thickness of this member is 32 inches, at Nora Springs.

8a—EATONIA ZONULE

Soft, yellow, shaly limestone and calcareous shale, absent at Nora Springs and other northern phases. Its most northward occurrence is at the Rock Grove Mill where it has a thickness of 6 inches. This thickness increases to the southward, reaching 27 inches some three miles southeast of the Rock Grove Mill. At Rockford the member is represented by about the same thickness of firm blue gray limestone which character is held to Marble Rock. At Greene it is again represented by shale and shaly limestone some 18 inches thick. The member, wherever found, carries a rich and diversified faunule, some 90 species being known. *Hexacrinus springeri* Thomas is very common and also *H. iowensis* Thomas. In the Baumgardner phase *Eatonia gregaria* n. s. and *Devonocidaris phimaevus* n. sp. are also common.

This member occupies the same horizon as the Athyris zonule but cannot be said to be a continuation of that bed since the Athyris zonule feathers out some three miles north of the appearance of the Eatonia beds. Its base is sharply set off from the Cyrtoceras zonule by a strong persistent unconformity.

II.—TRIGONOTRETA ZONE

This zone is normally composed of hard blue limestone, shaly limestone and at the base shale or magnesian limestone. It is well shown throughout western Floyd County, being present, at least in part, in every phase from Nora Springs southward to Greene. Wherever shown in Floyd County, its upper surface bears an unconformity which apparently marks a considerable period of erosion. Though the zonules and faunules of this zone vary considerably, the character of the whole remains fairly constant.

7a—CYRTOCERAS ZONULE

A series of hard, fine-grained limestones which are well developed along the Shellrock River from Nora Springs southward. The upper surface of this member shows considerable erosion, particularly in the vicinity of Nora Springs. Throughout western Floyd County the zonule is highly fossiliferous, the most abundant fossil being *Trigonotreta shell-*

rockensis n. sp. Numerous large cephalopods occur: three species of *Cyrtoceras,* three of *Orthoceras,* and a doubtful *Centroceras.* Other molluscs are common, as well as poorly preserved crinoids. The maximum thickness of this zonule, 35 inches, is found in the Baumgardner phase.

6a—SYMBATHOCRINUS ZONULE

This consists of from 4 to 8 inches of soft shaly limestone with thin shale partings, the member at most points being readily separated from the adjacent beds by its shaly nature, though in the Roseville and Marble Rock phases the distinction is wholly biologic. The dominant fossils are crinoids of several species, whose parts nearly always are so scattered that specific relations are uncertain. An undescribed *Symbathocrinus* is common, as well as plates of a doubtful *Poteriocrinus.* In Floyd and Butler counties the member contains abundant fucoidal casts similar to those of the genus *Gracilerectus* Webster.[18] Small brachiopods are common.

5a—STROPHEODONTA ZONULE

A series of firm, drab, shaly or slightly magnesian limestones, typically developed at Rockford where they reach their greatest thickness: 96 inches. There they contain a large Strophеodonta allied to *S. scottensis* n. sp. of this paper, occasional rugose corals, and casts of molluscs. From Rockford to Greene the zonule thins; partly by feathering out, and also by overlap on the Cedar Valley strata with which it is in contact from Greene nearly to Marble Rock. Northward from Rockford it also becomes thinner and slightly more magnesian, and at Nora Springs is represented by the following member.

5b—DECADOCRINUS ZONULE

This, like the preceeding, is composed of irregularly bedded, shaly or magnesian limestones, the later being most marked toward the north. The brachiopod faunule of the southern phases is largely absent here, while throughout the upper portion of the zonule there are thin lenticular layers

---

18 Am. Mid. Nat., Vol. 16, p. 288;1920.

of encrinital limestone. Some six species, of as many genera, of crinoids are known to occur in these lenses, while on other similar lenses are found an undescribed *Productella*, a very elongate pelecypod and dissociated echinoid remains. In the northern limits of Nora Springs the member becomes highly magnesian and passes below water level. At their next northward appearance, this and the beds above are dolomitized, nearly barren, and almost inseparable.

4a—POTERIOCRINUS ZONULE

This zonule is typically developed at Rockford, where it is represented by a series of calcareous shales, thin-bedded, shaly limestones, and lenses of encrinital limestone. Its most northward occurrence is at the Rock Grove Mill where it is 6 inches thick in contrast with 54 inches at Rockford. The predominant fossil is an undescribed *Poteriocrinus*, the calyx plates and stem ossicles of which occur by the thousands, in places making thin lenses of encrinital limestone. In the shaly layers fossils are abundant, particularly *Trigonotreta shellrockensis* n. sp. and *Stropheodonta scottensis* n. sp. With these are found casts of many molluscs and numerous bryozoans. Coral and stromatoporoids are comparatively rare.

4b—STEREOCRINUS ZONULE

This is the southward continuation of the Poteriocrinus zonule. It is best developed west of Marble Rock where it is composed of shale and shaly limestone. Like the Poteriocrinus zonule it is rich in fossils, about one-third of them being typical of the Poteriocrinus faunule. Its greatest thickness west of Marble Rock is 36 inches; there its base is in contact with the Cedar Valley strata. It thins rapidly to the east and south and is absent at Roseville and Greene.

3a—AGELACRINITES ZONULE

This name is given to an association of fossils which are found attached to the eroded surface of the Aulopora zone; in the Baumgardner phase the Pachyphyllum zonule being the substratum, and at Nora Springs the Gyroceras zonule. The most common fossil of this assemblage is the cystid, *Agelacrinites hanoveri* Thomas. With this there is another spe-

cies of the same genus as well as several species of *Aulopora, Hederella, Stomatopora, Spirorbis, Autodetus, Serpula, Crania* and other adnate types. This faunule is typically shown in the Baumgardner phase where apparently it has no stratum of its own, the fossils always being attached to the eroded surface of the stromatoporoids below or to the similarly eroded limestone matrix between. At Nora Springs it is also well shown, but in addition to being attached to the substratum, the same species also are found in a thin shaly stratum some 4 inches thick lying above the Aulopora zone. Here, too, there are several species of brachiopods not found in the Baumgardner phase.

I.—AULOPORA ZONE

This zone, part of which forms the "Stromatopora Reef" of Calvin's Nora Springs section, is one of the most unstable zones of the entire Shellrock. It is typically developed at Nora Springs, where it attains a maximum thickness of nearly 15 feet. To the north and west it appears above water level at several points between Nora Springs and Rock Falls, and in this distance shows but little decrease in thickness even though it becomes more or less magnesian with its fossils poorly preserved. South and east of Nora Springs it thins rapidly, the upper calcareous portion or "Stromatopora Reef" disappearing completely in the Baumgardner phase and the lower dolomitic portion disappearing northwest of Marble Rock. This eastward thinning apparently is due largely to erosion of the upper surface although the overlap on the underlying Cedar Valley strata undoubtedly had had effect in the more southern and eastern phases.

2a—GYROCERAS ZONULE

This member is shown only at the type exposure of the substage along the river cliff in the western part of Nora Springs. It is composed of hard, semilithographic limestone, about 5 feet in thickness near the middle of the cliff but absent at its southern end, where it has merged with the zonule beneath. It thins rapidly toward the northern end of the cliff, its final northward extent being represented by magnesian shale. The faunule is meager, consisting almost en-

tirely of molluscs of which two undetermined species of *Gyroceras* are most common.

2b—PACHYPHYLLUM ZONULE

This is the dominant member of the zone in the Nora Springs phase and is represented by hard, heavy-bedded limestone which is crowded with colonies of spheroidal stromatoporoids. Several species of *Aulopora* are common as well as many corals and brachiopods. The maximum thickness of this zonule, nearly 11 feet, is shown directly south of Nora Springs; southeastward it thins rapidly and disappears in the Baumgardner phase. In northwestern Nora Springs it also thins, being represented at the northern end of the type exposure by 36 inches of limestone in two heavy beds. Northwest of this the faunule has not been found.

2c—PLATYSCHISMA ZONULE

Like the preceeding zonule this consists of heavy bedded limestone, seen only in western Nora Springs. At the northern end of the type exposure, it is some 3 feet thick, holding that thickness to the south where it merges and intergrades with the Pachyphyllum zonule. Spheroidal stromatoporoids are occasional but they are much smaller than in the southern end of the cliff. Corals are more or less common throughout the zonule, while at the northern end of the cliff the member contains numerous beautifully preserved molluscs. Of these an undescribed form of *Platyschisma* is very common.

2d—CRASPEDOPHYLLUM ZONULE

Magnesian limestone and shaly dolomites which are typically developed in the Sherman Bluff phase, the zonule being equivalent to the more southern Pachyphyllum zonule. Stromatoporoids, however, are absent. In their place there are hundreds of colonies of an undetermined species of *Craspedophyllum*, the colonies of which are from 6 to 18 inches in thickness and often 7 feet in diameter, with these are associated several corals found also in the Pachyphyllum zonule as well as numerous brachiopods of species not found in more southern zonules.

This zonule is more or less continuously exposed from Sherman Bluff to Rock Falls. The corals, however, are largely absent in the more northern phases, their place being taken by branching indiotromids similar to those found in the upper portion of the Pachyphyllum zonule at Nora Springs and in equivalent beds at Mason City.

1a—DOLOMITE ZONULE

Dolomitic beds with occasional layers of shale, more or less continuous along the Shellrock from Rock Falls to the mouth of Losee creek west of Marble Rock in which distance they form the basal member of the Shellrock, being in contact with the eroded surface of the Cedar Valley. These beds obtain their greatest thickness, 8 feet, in the Baumgardner phase, although this thickness is nearly equalled in the Sherman Bluff and Rock Falls phases.[19] At Nora Springs they measure less than 4 feet in thickness. Throughout the area in Floyd County where these beds are exposed they have proven to be barren, being distinguished adequately by their lithologic characters.

B—PHASE DESCRIPTION

1—NORA SPRINGS PHASE

Since the Shellrock Stage is typically developed along the Shellrock River between Nora Springs and Rockford, with the type exposures in the immediate vicinity of Nora Springs, the first phase to be discussed is that to which the name Nora Springs may well be given.

In and near Nora Springs the Shellrock strata form a series of steep cliffs rising from either bank of the river and

---

19 Resting upon the eroded surface of the Nora substage in the extreme western portion of Nora Springs, there are from three to ten feet of the basal blue shales of the Juniper Hill formation, while slightly over a mile due west of Nora Springs the entire thickness of the Juniper Hill is shown and is capped by the Cerro Gordo substage and a remnant of the Owen substage of the Hackberry. These beds are continuous from this point westward to Portland and southward nearly to Lime Creek. Their northern and northwestern limits are obscured by drift.

extending from the northwestern limits of the town to the Rock Grove Mill, some three miles southeastward. In this area the beds are well exposed, no less than twenty excellent sections being offered. Most of these exposures are confined to beds of the Shellrock stage only, but along the river south of Nora Springs, and at the exposure in the western part of the town, the upper beds of the Cedar Valley stage rise above water level to form conspicuous ledges a few feet above water level.[19]

The Nora Springs phase can be most fully explained by giving in order the sections of the three type exposures of the substages which compose the Shellrock. The first of these, the type exposure of the Nora substage, is located at the "Junction" in the southwestern part of Nora Springs. Unfortunately here the upper zone is but poorly shown while the central (Platyrachella) zone is composed of but one member, thus in the number of zonules the Nora substage is not fully developed. The section follows:

NORA SUBSTAGE

Second Actinostroma Zone — INCHES

Pseudotectus zonule 58-62

Hard white limestone in one massive bed, composed almost entirely of crowded colonies of *Stromatopora, Actinostroma* and other stromatoporoids. Associated with these are many small brachiopods and molluscs and rare echinoid remains. These are to be found in the yellow, shaly matrix between the stromatoporoids.

PLATYRACHELLA ZONE

Unnamed zonule 60

Soft, yellow-brown, magnesian shale, distinctly stratified, weathering easily to a gritty yellow clay; apparently barren.

FIRST ACTINOSTROMA ZONE

Expansum Zonule 54-60

Hard white limestone in one massive bed, composed of laminar stromatoporoids, particularly *Ac-*

tinostroma expansum (H. & W.) A compound idiostromid common with occasional tabulate corals. The upper surface moderately undulating; lower highly so.

Unconformity

ROCK GROVE SUBSTAGE

Schizophoria Zone

Ulsterensis zonule 54-60

Firm, brownish, impure dolomite in several layers, which increase in thickness upward. Upper surface eroded and marked by channels and by domes 10 to 18 inches in diameter and 2 to 6 inches high. Upper portion contains abundant casts of *Spirifer ulsterensis* n. sp., *Schizophoria floydensis* n. sp. and other fossils. Full thickness not shown, the base being covered by sod.

The type exposure of the Rock Grove substage is located on the eastern bank of the Shellrock River a short distance southeast of Nora Springs, where the beds of the Shellrock Stage form a nearly vertical cliff along the river. In the upper beds of the section is an abandoned quarry. In general all of the beds are well exposed though the more shaly portions show a tendency to slump. The section is as follows:

NORA SUBSTAGE

Second Actinotroma Zone. INCHES

Pseudotectus zonule 48-54

Hard white limestone like that of the type exposure; fauna essentially similar.

Platyrachella Zone.

Unnamed zonule 72

Yellow brown, magnesian shale, unfossiliferous.

First Actinostroma Zone.

Expansum zonule 42-50

Firm, gray-buff limestone so crowded with stromatoporoids as to appear white. *Actinostroma expansum* (H. & W.) typical; *A. pulchra* less com-

mon than at Nora Junction. Lower surface strongly undulating.

Unconformity

ROCK GROVE SUBSTAGE

Schizophoria Zone

Ulsterensis zonule 54-60

Hard, brown, crystalline, and rather impure dolomite which tends to intergrade with the shale below. Upper surface deeply channeled and marked by domes from 1 to 3 feet in diameter and commonly 8 inches high. Casts of *Spirifer ulsterensis* n. sp. and *Schizophoria floydensis* n. sp. abundant; other species less common.

Atrypa zonule 90

Soft, blue-gray, magnesian shale distinctly stratified and somewhat indurated at the top where it intergrades with the dolomite above. Shale easily weathered, breaking down into a gritty blue clay. No fossils noted.

Paracyclas Zone.

Pterinea zonule 80

Soft, yellow, magnesian limestone or impure dolomite in one heavy bed, weathers to a gritty yellow clay and shapeless blocks, the more durable portions deeply pitted. No fossils noted.

Gomphoceras zonule 60

Hard, blue-gray, very durable limestone in thin, regular layers 1 to 2 inches thick, separated by like thickness of fissile gray shale. Casts of molluscs common; fish and crustacean (?) remains occasional. Conformable with the bed above and in places apparently intergrading with it.

Unconformity

MASON CITY SUBSTAGE

Lepidocentrus Zone

Camarophoria zonule 15

Soft, yellow-brown, argillaceous limestone in one

shattered bed which weathers to a gritty yellow clay or geest. Contains many species of rugose and compound corals, as well as abundant brachiopod and echinoderm remains. The most common forms are *Cyathophyllum floydensis* n. sp., *Phillipsastrea minutissima* (Webster), *Stropheodonta cicatricosa* n. sp. *Camarophoria paupera* n. sp. and *Gypidula* sp. The upper surface of the bed, where well shown, is pitted and more or less marked by hollow, rust-lined cavities.

Unconformity

Trigonotreta Zone

Cyrtoceras zonule 20

Hard, fine-grained, blue-gray limestone in one massive and very durable bed generally forming a ledge along the face of the exposure. Upper surface moderately undulating and occasionally iron stained. *Trigonotreta shellrockensis* n. sp. abundant; casts of molluscs common, as well as poorly preserved crinoidal remains.

Symbathocrinus zonule 8-10

Soft, grayish, shaly limestone in thin layers interbedded with fissile gray shale; upper and lower parts intergrading with the adjoining beds. Fossils abundant, chiefly disassociated crinoid plates and stem ossicles, and small brachiopods. Casts of *Gracilerectus* very common.

Decadocrinus zonule 64

Hard, drab, magnesian limestone in several irregular layers with occasional thin lenses of encrinital limestone. Full thickness not shown, since the base is below water level. Fossils rare or absent in the magnesian portion but abundant in the encrinital lenses. Several species and genera of crinoids noted as well as many undetermined brachiopods and pelecypods.

The third section given for this region is that of the type exposure of the Mason City substage, in the western part of the town of Nora Springs. A section of this cliff was given by Calvin.[20] Virtually all of the beds exposed here belong to the Mason City substage; they form a steep cliff rising directly from the water and extending along the eastern bank for nearly half a mile. Although the strata are affected by gentle folds, their general plane is nearly level. The cliff is higher at its northern end, however, and there the lower part of the Rock Grove substage is shown capping the Mason City. The section follows:

ROCK GROVE SUBSTAGE

Schizophoria Zone — INCHES

Atrypa zonule 30

Soft, blue-gray, magnesian shale, distinctly stratified where freshly exposed but generally represented by a belt of gritty blue clay. Full thickness of the bed unknown, since it extends beneath the sodded slope above; its base apparently is conformable with the bed below. No fossils noted.

Paracyclas Zone

Pterinea zonule 46

Soft, buff, magnesian limestone or shaly dolomite in one considerably shattered bed, apparently conformable above and below. A single poorly preserved cast of *Pterinea* sp. the only fossil noted.

Gomphoceras zonule 30

Hard, blue-gray, compact limestone in thin, regular layers 1 to 3 inches thick, interbedded with layers of fissile gray shale of nearly equal thickness; lower surface moderately undulating. Casts of molluscs and fish remains common; small spheroidal stromatoporoids rare.

---

20 Iowa Geol. Surv. Vol. 7, p. 154; 1897.

Unconformity

MASON CITY SUBSTAGE

Lepidocentrus Zone.

Camarophoria zonule 18

Soft, yellow, argillaceous limestone in one shattered bed which weathers to a gritty clay. Upper surface of the bed moderately undulating and marked by numerous hollow, rust-lined cavities. Fossils abundant and well preserved: compound corals make up the bulk of the fauna, but not the greatest number of species. The most common forms are *Camarophoria paupera* n. sp., *Hyothyridina magister* n. sp., *Stropheodonta cicatricosa* n. sp., *Strobilocystites schucherti* Thomas, *Cyathophyllum floydensis* n. sp., *Alveolites* sp. and several forms of *Phillipsastrea*. *Lepidocentrus thomasi* n. sp. is common as well as other echinoid remains. The whole fauna numbers over 100 species.

Alhyris zonule 24

Hard, blue-gray, crystalline limestone, generally in two layers, conformable with the bed above and intergrading with it at the southern end of the cliff. At the northern end of the cliff this member thickens considerably and becomes argillaceous. Laminar and hemispherical stromatoporoids abundant; brachiopods numerous, similar to those in the bed above.

Unconformity

Trigonotreta Zone.

Cyrtoceras zonule 24

Hard, fine-grained, blue-gray limestone, in one bed; generally frost shattered; upper surface somewhat eroded and iron stained. *Trigonotreta shellrockensis* n. sp. abundant; several species of cephalopods and pelecypods common, as well as poorly preserved crinoidal remains. This bed is thickest at the southern end of the cliff.

Symbathocrinus zonule 6-8
Soft, shaly, blue-gray limestone with fissile, gray shale, intergrading more or less with the beds adjoining. Fossils abundant, consisting largely of scattered crinoidal remains, small brachiopods and many fucoidal casts.

Decadocrinus zonule 50
Soft, light buff, shaly and rather magnesian limestone in one shattered bed, attaining its greatest thickness at the northern end of the cliff. Apparently barren.

Agelacrinites zonule 0-6
Soft, yellow, gritty shale in thin layers which to the north become a magnesian limestone; absent at the southern end of the exposure though its fauna adheres to the eroded surface of the bed below. Its fauna consists largely of adnate forms —*Crania, Agelacrinites, Aulopora,* etc. At the northern end these and numerous other brachiopods, the most common of which is an undetermined *Platyrachella.*

Unconformity

Aulopora Zone.

Gyroceras zonule 0-48
Hard, light-buff, lithographic limestone in one or two beds, thickest near the center of the exposure. To the north it feathers out, while to the south it intergrades with the bed below. Upper surface eroded and undulating; lower conformable with the bed below. Fauna largely molluscan; two large, undescribed species of *Gyroceras* the commonest forms.

Pachyphyllum zonule 36-96
Hard, white, compact limestone with occasional thin shaly layers. At the southern end of the cliff it is in one massive bed nearly 8 feet thick, crowded with colonies of spheroidal stromatopor-

oids. Here, due to the absence of the Gyroceras zonule, its upper surface is strongly eroded. To the north the bed becomes divided into four nearly equal beds the upper two of which carry the typical stromatoporoids. Other typical fossils of this bed are corals of the genera *Cyathophyllum, Craspedophyllum, Alveolites, Diphyphyllum, Cladopora* and *Pachyphyllum.*

Platyschisma zonule 36

Limestone similar in texture to the above and being the northward extension of the two lower layers of that bed. Contains many molluscs the most common of which is an undescribed *Platyschisma.*

Dolomite zonule 40-46

Hard, buff, crystalline dolomite with occasional locally developed layers of argillaceous limestone, gritty shale, and sublithographic limestone. Upper surface of this bed generally poorly defined and tends to intergrade with the bed above; base sharply unconformable on the Cedar Valley beds below. No fossile noted.

Unconformity

CEDAR VALLEY STAGE 84

Hard, white, durable, lithographic limestone, apparently slightly brecciated, extending below water level; its upper surface strongly undulating. This bed can be divided in three parts. The uppermost of these, some 15 inches thick, is a hard lithographic limestone, charged with rugose and compound corals. This portion is shown only along the northern portion of the exposure. Nearly 25 forms of corals from this bed have been studied; not one species and but few genera are found in the overlying Shellrock beds. Beneath this, and separated from it by a stylolitic bedding plane are some 3 feet of mottled, lithographic limestone which appears to be nearly barren. Beneath this,

and likewise separated by a stylolitic bedding plane is a bed of hard, drab, crystalline limestone in one considerably shattered bed which extends below water level. It is rich in fossils nearly all of which are brachiopods similar to those found in the corresponding horizon at Marble Rock and Greene. Of the 10 species found here, none occur in the Shellrock.

The total thickness of each substage at any one point is: Nora, 15 feet; Rock Grove, 24 feet; Mason City, 22 feet.

2—BAUMGARDNER PHASE

Southward from Rock Grove Mill the valley of the Shellrock widens and the hills recede from the river and become less steep. Exposures are more widely scattered and offer poorer sections than those near Nora Springs, rarely showing more than one substage. Enough exposures exist, however, to allow tracing of the beds nearly to the northern limits of Rockford.

Changes in the strata appear at the Rock Grove Mill, three miles southeast of Nora Springs. Here the Eatonia zonule of the Lepidocentrus Zone appears: 6 inches of soft, shaly limestone carrying virtually the same faunule that it bears in the phases farther south. The Mason City substage is further modified by the appearance of the Poteriocrinus zonule at the base of the Trigonotreta zone, and though here a limestone, its fauna is nearly the same as in the shaly Rockford phase. The Pachyphyllum zonule of the Aulopora zone is but 6 feet thick. From the Rock Grove Mill to the site of Baumgardner's Mill, 2 miles farther southeastward, the members of the Mason City substage show few changes, and these consist wholly of variations in thickness of the different zonules. Thus the Eatonia zonule becomes nearly 2 feet in thickness and the Poteriocrinus zonule shows similar increase. The Lepidocentrus zone is also represented by the Cladopora zonule which is somewhat thinner than at Rock Grove and considerably thinner than the corresponding Camarophoria zonule at Nora Springs. The most important feature of the Baumgardner phase is the thinning and final disappearance

of the Pachyphyllum zonule of the Aulopora zone. At Baumgardner's Mill an anticline brings up the uppermost beds of the Cedar Valley strata which correspond to the lower two parts of these beds in the Nora Springs section, (No. 1, p.348).

Changes in the upper two substages are also noted. The Rock Grove has added a western phase of the Productella zonule, which appears at the top of the Pterinea zonule. The Nora substage begins to assume its typical character, for though the upper and lower beds are unchanged, the Platyrachella zone is here divided by a northward extension of the Syringopora zonule which separates the two shale zonules. Faunally these beds differ little from the Nora Springs phase.

As has been said, the Shellrock beds are nowhere shown completely, but the Baumgardner phase may be considered to be typically developed in the southwest quarter of section 28, T. 96 N., R. XVIII W., where the entire Mason City is present above the uppermost Cedar Valley beds. The various beds of the Rock Grove substage are best shown about a half mile to the north, while the Nora is completely shown about a mile southeast of Baumgardner Mill. The thickness of the three substages at these localities is: Nora, 15 feet; Rock Grove, 19 feet; Mason City, 29 feet. This is the greatest thickness of the Mason City in Floyd County, representing an increase of 7 feet over the Nora Springs phase. The Nora, however, is unchanged, while the Rock Grove has suffered a decrease of 5 feet.

3—RUDD PHASE

Traces of this phase appear in the Rock Grove substage of the Baumgardner phase, but it is not till the valley of Flood creek is reached, four miles to the northeastward, that the typical Rudd phase appears. Here, near the town of Rudd, the stream has cut through the drift and excavated a channel some 20 feet deep in the upper beds of the Shellrock Stage. Farther from the town the valley walls are low and gradual in slope, and the exposures unsatisfactory, since they seldom show more than one zonule.

In this phase the Mason City substage is poorly shown. The Lepidocentrus zone is known, being represented by an

eastern phase of the Cladopora zonule. The Eatonia zonule is missing, as at Nora Springs, allowing the Cladopora zonule to rest unconformably upon the Cyrtoceras zonule of the Trigonotreta zone. Faunally the beds show little change from the Baumgardner phase.

The Rock Grove substage, however, is exceptionally well developed and is more complex than in the Nora Springs and Baumgardner phases. The Paracyclas zone has added some 3 feet of shaly limestone carrying an abundant molluscan fauna, and in the upper portion many brachiopods; the Pterinea and Gomphoceras zonules, although somewhat thinner than along the Shellrock, preserve their lithologic character.

The upper Schizophoria zone is variously charged. Like the underlying zone, it has added another zonule, the Loxonema, but this increase is more than equalled by the thinning of the upper or Ulsterensis zonule. Here the heavy-bedded dolomite, so conspicuous at the top of this member at Nora Springs, is largely eroded away; and since it carries most of the fauna, the zonule at Rudd is sparingly fossiliferous. The Atrypa zonule preserves much the same character and thickness that it shows on the Shellrock. Beneath it, and forming the base of the zone, lies the new member, the Loxonema zonule, nearly 18 inches thick. The faunule of this bed is rich, the three dominant species being *Schizophoria floydensis* n. sp. *Loxonema* sp. and *Diaphorostoma* sp., the first making up nearly half the specimens found. There are some thirty other bryozoans, brachiopods and molluscs, few of them found in the underlying Mason City beds. The thickness of the Rock Grove in this phase is 17 feet.

The Nora substage, though poorly shown in the immediate vicinity of Rudd, appears almost in entirety one mile to the north and west. The second Actinostroma zone retains the faunal and lithologic character which it shows at Nora Springs, but is somewhat thinner. Beneath it is a gritty, yellow, magnesian shale forming the Platyrachella zone, while beneath this is a bed of yellow-brown, argillaceous limestone corresponding to the first, or lower, Actinostroma

zone. This differs markedly from the phases shown along the Shellrock, and because of the abundance of *Prismatophyllum oweni* n. sp. it is termed the Prismatophyllum zonule. The laminar stromatoporoids characteristic of this horizon along the Shellrock are almost absent, their places being taken by corals, which include two species of *Phillipsastrea* and several of *Ptychophyllum, Alveolites,* and *Cladopora* in addition to the *Prismatophyllum.* There also is a rich brachiopod and echinoderm fauna whose species are not typical of this horizon farther west. The entire thickness of the Nora substage here is but 11 feet.

About six miles southeast of Rudd, along a road cutting west of the Flood creek channel, beds of Shellrock age are exposed, which extend from the top of the Gomphoceras zonule to the top of the first, or lower, Actinostroma zone of Nora. In appearance these beds are very similar to the Rudd phase. The Nora is represented by a remnant of the Prismatophyllum zonule, which though only 12 inches thick (compared with 36 at Rudd), carries the same faunule. The Ulsterensis zonule is almost absent and the shale beneath is markedly thinner. The Loxonema zonule is replaced by the Crania zonule, a much shalier stratum, characterized by abundant bryozoans and brachiopods. Molluscs apparently are absent, but there are numerous echinoderms. The Productella zonule is much the same as at Rudd.

About one mile southeast of this cut, and directly east of Rockford, beds of the Mason City substage, as well as the upper beds of the Cedar Valley, appear along the banks of Flood creek, though they are too badly shattered and too poorly exposed to give a section. No other exposures are known along Flood creek until Roseville, 7 miles southeast, is reached, the intervening territory being deeply covered by drift.

4—ROCKFORD PHASE

From Baumgardner Mill to Rockford the valley of the Shellrock is broad, with gently sloping hills some distance from the river, in whose flood plain are but few exposures. At Rockford the valley again narrows, the hills rising direct-

ly from the river. The rocks lie in a series of broad, low anticlines in which the upper Cedar Valley is again exposed; and above them, beds extending to the top of the Shellrock. On the banks of Lime Creek, west of Rockford, the upper beds of the Shellrock are shown, as well as the lower part of the Juniper Hill formation. This elevated, slightly folded area extends to the confluence of the Lime Creek and Shellrock, south of which the valley of the Shellrock again widens.

The Rockford phase is typically shown on the eastern (left) bank of the Shellrock southeast of Rockford. A few of the beds are obscured by talus, but these are well exposed along Lime Creek south and west of the town, so that by combining these two sets of exposures the complete sequence is obtained.

Compared with the Baumgardner phase, three miles northwest, the chief differences shown by the Nora substage are a thickening of the various zonules and a greater abundance of fossils. This is especially true of the Pseudotectus zonule at the top of the Nora, and of the Schuchertella zonule at the base of the Platyrachella zone, both of which here carry rich and varied faunas.

Several characters of the Rock Grove substage recall its development in the Rudd phase; both the Loxonema and Productella zonules are present, although somewhat thinner than at Rudd. The Ulsterensis zonule of the Schizophoria zone has much the same thickness and fauna as at Nora Springs, but it is separated from the overlying Nora by a member not present in any other phase. This is the Strobilocystites zonule, a bed of yellow argillaceous limestone charged with corals, brachiopods and echinoderms. It is developed only on the eastern bank of the Shellrock, not being shown along Lime Creek west of Rockford, where the Nora rests directly upon the Ulsterensis zonule. This new member is unconformable with the Nora substage and can be traced south and east some three miles, and then is removed by erosion.

The Mason City strata here differ greatly from those at Baumgardner Mill. The Lepidocentrus zone is again represented by the Camarophoria zonule, with much the same

lithologic character and fauna that mark it at Nora Springs: the Athyris zonule of the Nora Springs phase is lacking at Rockford but the Eatonia zonule consists of more than three feet of firm, yellow-buff limestone, bearing a fauna apparently the same as in the Baumgardner phase. The Trigonotreta zone thickens, the lower shaly portion, (Poteriocrinus zonule) increasing to some four feet and carrying a very rich and varied fauna. Above it lie some 8 or 9 feet of buff limestone, the Stropheodonta zonule, carrying a fauna composed largely of brachiopods and molluscs. The Aulopora zone is represented only by the lower or Dolomite zonule which here reaches a thickness of nearly 9 feet.

The thickness of the Nora substage in these exposures is 16 feet, of the Rock Grove 18 feet, and of the Mason City 27 feet. The Nora reaches nearly its maximum thickness while the other two substages show a slight decrease when compared with the Nora Springs and Baumgardner phases.

5—MARBLE ROCK PHASE

Southward from Rockford the valley of the Shellrock offers virtually no exposures for nearly three miles, chiefly because of a broad syncline which carries most of the Shellrock strata below water level. Except for one exposure of the Nora, at Fisher's bridge, the beds do not appear on the western side of the river until Losee creek is reached, two miles west of Marble Rock. On the eastern bank of the Shellrock the beds start to rise near the mouth of Ballard creek, three miles southeast of Rockford, and are exposed more or less continuously along the Shellrock to Marble Rock, rising gradually until in the town the base of the Shellrock beds is nearly forty feet above water level.

In this distance considerable changes appear throughout the stage. In the series of exposures which extend nearly to Marble Rock, the Nora substage shows rapid thinning of its various members. The second, upper, Actinostroma zone apparently does not reach Marble Rock, being noted last some two miles northwest of the town. The Platyrachella zone becomes less than 3 feet in thickness, the lower shale (Schuchertella zonule) being the most persistent and continuing

nearly to the limits of Marble Rock. The lower (first) Actinostroma zone, represented by a southern phase of the Prismatophyllum zonule, is present but is only about 2 feet thick.

The Rock Grove substage is more readily traced, its several zonules appearing in nearly all of the exposures. At Ballard creek the Ulsterensis zonule at its top consists of a thin remnant which is entirely absent where this horizon is next exposed two miles southeastward, where the lower portion of the Nora rests upon the shaly Atrypa zonule. The Productella zonule continues nearly to Marble Rock, but the Loxenema zonule disappears a short distance south of Ballard creek. About a mile north of Marble Rock the Atrypa zonule feathers out, allowing the first Actinostroma zone of the Nora to rest upon the here eroded surface of the Productella zonule. This is the most easterly point at which these two beds have been found. The Pterinea and Gomphoceras zonules at the base of the Rock Grove continue southward through this area with but little change.

With the exception of these two zonules, the Nora and Rock Grove substages are not shown on the western bank of the Shellrock. On the other hand, although exposed at several points on the eastern bank, the Mason City substage is best shown along the western side of the stream, particularly in the vicinity of Losee creek. The beds are exposed at several points in this vicinity, and at the most westerly of these there is a remnant of the Dolomite zonule. This does not exceed a foot in thickness, and generally is found in the troughs of the eroded Cedar Valley below; less than a mile southeastward it is absent. The Poteriocrinus zonule, at the base of the Trigonotreta zone, is replaced by the Stereocrinus zonule, which, though lithologically similar, carries a distinct faunule. Half a mile southeast of the mouth of Losee creek, this zonule forms the base of the Shellrock, resting upon the Cedar Valley beds. The Cyrtoceras, Symbathocrinus, and Stropheodonta zonules, composing the rest of the Trigonatreta zone, are merged together in a single bed less than 5 feet thick, and the Lepidocentrus zone consists of one thin member

greatly resembling the Cladopora zonule of the Baumgardner Phase. Northwest of Marble Rock, the shaly Stereocrinus zonule is less than 2 feet thick, compared with 3 feet at Losee creek.

Near Marble Rock the beds of the Cedar Valley stage are conspicuous, forming steep cliffs which are capped by the stromatoporoidal lithographic beds which characterize the upper portions of the stage. Because of their durability, these beds stand out boldly, while the overlying Shellrock beds, being softer, are more easily weathered—one of the reasons Shellrock beds have not previously been detected here. The other is that they must be sought on the gentle slopes back of the cliffs bordering the stream.

While the full thickness of the upper two substages of the Shellrock are not shown at Marble Rock, measurements of the different members at the point nearest Marble Rock may prove of interest. The amount of decrease as compared with the Rockford phase is also given. These measurements are: Nora: thickness, 6 feet, decrease 10 feet; Rock Grove: thickness 6 feet; decrease 12 feet; Mason City, (at Losee Creek) thickness 9 feet, decrease 19 feet. There is a further decrease of 18 inches in the last named at Marble Rock, caused by thinning of the basal Stereocrinus zonule.

6—ROSEVILLE PHASE

Near Roseville, a hamlet on Flood creek, five miles northeast of Marble Rock, a phase of the Shellrock beds is shown which is very similar to that of the Marble Rock phase. The Nora substage apparently is absent and only the lowermost (Gomphoceras) zonule of the Rock Grove substage is shown. The entire thickness of the Mason City substage is present, resting, as at Marble Rock, upon the eroded surface of the Cedar Valley with pronounced unconformity.

The Lepidocentrus zone here is but 7 inches thick and carries a faunule closely allied to that of the Cladopora zonule. As at Marble Rock, the Eatonis zonule is absent and the three zonules of the Trigonatreta zone are united into one bed, their separation being difficult. The shaly Stereocrinus zonule is

absent, allowing the Stropheodonta zonule to rest upon the Cedar Valley strata.

The thickness of the Mason City substage is about 6 feet, a decrease of 3 feet in the five miles from Marble Rock. This rate of decrease would allow the substage to extend some ten miles farther eastward before its final disappearance, but is unknown along the Cedar River in the region thus indicated. That the beds ever extended more than half this distance is doubtful in view of the rapid decrease from Rockford to Marble Rock.

7—GREENE PHASE

Exposures are rare on the eastern side of the Shellrock from Marble Rock southward to Greene, the region being deeply covered by drift. On the western side, however, exposures are fairly continuous, the strata lying in a syncline which brings the top of the Cedar Valley but a few feet above water level. The Shellrock beds are frequently exposed but are so thin that they do not form cliffs like those at Nora Springs and Rockford. Only the Mason City and lower portion of the Rock Grove substages are exposed, the southernmost exposure of the Nora now known being almost two miles due south of Marble Rock, where a remnant caps a hill near the center of section 20 of Union township.

About a mile northwest of Greene the strata rise rapidly; near Greene the top of the Cedar Valley is from 30 to 50 feet above the Shellrock river. Here, as at Marble Rock, the lithographic upper beds form steep bluffs which extend southward on either side of the river nearly to the mouth of Flood Creek.

Shellrock strata are exposed on the west bank of the stream northwest of Greene, at the point where the beds start to rise; from there, however, the exposures trend to the southwest and Shellrock strata are no longer exposed along the banks of the river.

In sections 13 and 14 of Coldwater township, Butler County, the strata are again affected by a syncline, so that along the banks of Coldwater creek beds of the Shellrock reappear as isolated outliers whose general trend is east and west. The

full thickness of the Mason City substage is shown; it rests, as at northern points, on the eroded Cedar Valley, and is covered by the lower portion of the Rock Grove substage. Exposures lie on either bank of the stream, but beds higher than the Paracyclas zone have not been found.

The Cedar Valley beds resemble those at Marble Rock, the upper portion being a lithographic limestone bearing a fauna composed largely of a spheroidal stromatoporoids, with occasional rugose corals, and more commonly, brachiopods. The unconformity at the top of these beds is marked, the vertical inequalities sometimes amounting to a foot. In view of the extreme durability of these limestones this must signify a considerable period of erosion.

The Mason City substage consists of little more than a remnant. As usual, the Lepidocentus zone (Cladopora zonule) forms the top, being here some 9 inches thick. A remarkable feature of this phase is the reappearance of the Eatonia zonule. It bears the typical faunule, and has the same lithologic character that marks it in the Baumgardner phase. The members of the Trigonotreta zone again are separated, the zone being represented by the Cyrtoceras, Symbathocrinus, and Stropheodonta zonules, carrying much the same faunules that they hold at Rockford. The basal, shaly Stereocrinus zonule is absent, as in the Roseville phase, allowing the Stropheodonta beds to rest upon the Cedar Valley.

Both the Pterinea and Gomphoceras zonules of the Paracyclas zone are present, each being lithologically similar to the Rockford and Nora Springs phases. The total thickness of the Mason City substage in this phase is slightly less than 4 feet, while the exposed portion of the Rock Grove measures less than 6 feet.

Shellrock beds are again indicated in the central and western parts of Section 1 of Benezette township, Butler County. These apparently represent another outlier similar to those just mentioned. No definite exposures of the beds are known, but on the crests of the hills along the south side of Coldwater creek blocks of limestone have been plowed up which

are of the lithologic character of the Lepidocentrus zone. They carry as fossils *Cyathophyllum floydensis* n. sp., *Phillipsastrea minutissima* (Webster) and laminar stromatoporoids such as characterize that zone in the Nora Springs phase. Evidently this is a southward extension of the Camarophoria zonule.

The contact of the Shellrock beds with the Cedar Valley is not shown, although the latter offers numerous good exposures along the creek in the central part of the section. The top of the Cedar Valley here is composed of a sublithographic limestone with much interbedded shale. This is rich in fossils, most of which are corals, apparently identical with those found in the uppermost bed of the Cedar Valley at Nora Springs. With these are occasional branching idiostromids and small crinoid stems. This evidently is the horizon referred to by Arey [21] in his report of Butler County. Beneath this bed is the horizon of lithographic beds carrying a fauna of spheroidal stromatoporoids.

8—REED CREEK PHASE

Returning again to Nora Springs, the succession of beds in the Shellrock stage now may be traced northward and westward along the Shellrock River to Rock Falls.

From the northwestern limits of Nora Springs the beds dip rapidly westward, while the river valley becomes shallow. For nearly two miles only the Nora and the upper part of the Rock Grove substage are exposed. Some two miles northwest of Nora Springs, on the west bank of the river, an anticline brings up the Rock Grove and upper Mason City beds. This point is about a half mile southeast of the mouth of Reed creek and forms the typical locality of that phase.

In this distance the beds change considerably. The upper Actinostroma zone becomes thicker and loses it fauna of small molluscs and brachiopods, though retaining the laminar stromatoporoids. Because of the abundance of an undescribed *Stromatopora* it is here termed the Stromatopora zonule. The Platyrachella zone again assumes the character

21 Iowa Geol. Surv. Vol. 20, p. 30; 1910.

shown at Rockford, being divided by a bed of shaly dolomite (Ptychophyllum zonule) which first appears near the Floyd County line with a thickness of 10 inches which increases to 20 in the Reed Creek phase. Its faunule is composed largely of brachiopods, particularly *Platyrachella ballardi* n. sp. of a form very similar to that from the Schuchertella zonule at Rockford. The shale beneath, which forms the Schuchertella zonule farther south, is here highly magnesian, containing fossils only as casts. Of these the most common is *Platyrachella ballardi* n. sp., the specimens, however, being much larger than those from Rockford. Casts of a rugose coral are also common.

The most important change takes place in the lower Actinostroma zone. Near the Floyd County line a thin bed of brown limestone appears at the top of this zone, being separated from the Expansum zonule beneath by a strong bedding plane. This bed increases until in the Reed Creek phase it is nearly 2 feet thick. This is termed the Macgeea zonule, the faunule of which consists almost entirely of corals. At the base there are abundant stems of a robust *Cladopora* and a much smaller, cylindrical *Alveolites*. Toward the top these are replaced by thousands of rugose corals belonging to the genera *Macgeea, Ptychophyllum, Cyathophyllum* etc. with occasional masses of *Phillipsastrea* and *Prismatophyllum* while a slender undetermined idiostromid is also locally abundant. With the increase in thickness of the Macgeea zonule the Expansum zonule becomes thinner, dropping from 54 inches at the County line to about 24 inches at Reed Creek. At the same time it changes from a hard gray limestone to a dirty brown, submagnesian limestone, while the laminar stromatoporoids typical of the Expansum zonule gradually give way to spheroidal forms, some of which attain a diameter of nearly 3 feet. Coincident with this is the appearance of brachiopods, particularly a flattened form of *Trigonotreta shellrockensis* n. sp. This member is widely different from the Expansum zonule.

The Rock Grove substage is well exposed in this phase but is considerably modified. The uppermost (Ulsterensis)

zonule begins to change in character near the Floyd County line. It retains its impure dolomitic character but becomes more thinly bedded and shows a considerable decrease in thickness. *Spirifer ulsterensis* n. sp., so typical in the southern phases, gradually disappears and for a short distance the zonule is nearly barren. At Reed Creek it again becomes fossiliferous, bearing an undetermined *Conularia* and several species of fish; it may be termed the Conularia zonule. The underlying shaly Atrypa zonule retains its character but becomes thinner. The Paracyclas zone is well shown at the anticline already mentioned. Here it is composed of two zonules: the upper, 18 inches thick, is a thin-bedded dolomite which represents the Pterinea zonule, while the lower, composed of hard brown limestone in thin layers represents the Gomphoceras zonule.

Only the upper part of the Mason City substage is shown here and it is so heavily dolomitized that recognition of the members is difficult. Fossils are abundant but consist of casts or of calcite masses which show only the general form of the organism. *Cyathophyllum floydensis* n. sp., *Phillipsastrea minutissima* (Webster), *Camarophoria paupera* n. sp. *Hypothyridina magister* n. sp., have been identified as well as several other species which are typical of the Camarophoria member of the Lepidocentrus zone as it is developed at Nora Springs. Less than three feet of the Mason beds are exposed at this point, and probably but this one zone is present.

The thicknesses of the two upper substage in this phase are: Nora, 19 feet, an increase of 4 feet over the Nora Springs phase; Rock Grove 15 feet, a decrease of 9 feet.

9—BJORGASON PHASE

From the anticline of the Reed Creek phase the beds dip northward and the Mason City substage is not shown for a distance of about one half mile. A short distance north of the south line of Falls township, Cerro Gordo County, the Mason City reappears near water level and rises until the full thickness of the substage is shown. This elevation is held, with but minor changes, for over a mile northward, the strata being exposed on both banks of the river. In this dis-

tance the beds change so greatly that it is necessary to divide them into three phases to correlate properly the northern and southern sets of exposures.

The first of these, the Bjorgasòn phase, is best shown on the west bank of the Shellrock in the southeast quarter of section 35, T. 97 N., R. XIX W.—the locality at which the Mason City substage reappears. Here the beds form a steep cliff, rising directly from the river and affording a complete section of the Nora and Rock Grove substage as well as of the upper portion of the Mason City.

In the Nora substage the upper Actinostroma zone retains its characters of the Reed Creek phase. The Platyrachella zone consists of three zonules, the upper and lower shaly portions showing dolomitization, while the central (Ptychophyllum) zonule is represented by shaly dolomite which intergrades with the softer bed below; all of the zonules apparently are barren.

The lower Actinostroma zone, however, suffers the more marked changes. The Macgeea and Expansum (?) zonules of the Reed Creek phase are represented by two beds of soft, brown, finely crystalline dolomite. Beneath these another zonule appears slightly north of Reed Creek, thickening to the north and represented in the Bjorgason phase by 15 inches of dolomite similar to that above, but somewhat firmer. All of these zonules appear to be barren. In places the bedding planes between them assume the character of unconformities and the base of the lowermost zonule is strongly undulating.

The Rock Grove substage is well shown in a series of exposures leading up to the Bjorgason phase. From the Reed Creek phase northward the uppermost (Conularia) zonule can be traced; it thins from 30 inches to about 8 at its last exposure, about one fourth of a mile east of the present phase exposure. This thinning is caused by erosion, which in the Bjorgason phase has quite removed the zonule, allowing the Nora substage to rest upon the shaly Atrypa member. The two zonules of the Paracyclas zone are considerably modified, the upper (Pterinea) zonule consisting of thin-bedded dolo-

mite about a foot in thickness, while the basal (Gomphoceras) zonule becomes dark and heavy-bedded, and loses the shale partings typical of it in all southern phases.

The Mason City substage, in the Bjorgason phase, shows heavy dolomitization with attendant loss of fossils. The coralline faunule of the uppermost Camarophoria zonule is indicated by large masses of calcite, while the brachiopods appear to be absent; only one member represents the Lepidocentrus zone. Its base is marked by a strong bedding plane beneath which lie 4 feet of heavy-bedded, magnesian limestones which extend beneath water level. These apparently represent the Trigonotreta zone, but scarcity of fossils and the similarity of the beds makes it impossible to satisfactorily delimit the zonules.

In this phase the thickness of the Nora substage is 17 feet and of the Rock Grove, 10 feet. This shows a decrease of 2 feet in the former and 5 feet in the latter, from thickness in the Reed Creek phase.

10—SHERMAN BLUFF PHASE

The second phase in this vicinity is termed the Sherman Bluff phase. It is well shown along the east bank of the Shellrock, in a steep cliff beginning a short distance north of the Bjorgason phase and extending beyond the middle of section 35, a distance of about a quarter of a mile. Here uplift brings to view practically the full thickness of the Mason City substage, as well as the two substages above it.

The Nora substage shows little change from the Bjorgason phase, though at the north end of the cliff the three members of the Platyrachella zone are dolomitized. Except for the upper Actinostroma zone, the entire substage is barren.

The Rock Grove substage suffers considerable change. As in the Bjorgason phase, the Conularia zonule is absent, and the other member of the Schizophoria zone, the Atrypa zonule, becomes thinner, finally disappearing a short distance north of the main exposure. In the Paracyclas zone, the Pterinea zonule is either absent or has united with the Gomphoceras zonule to form a series of strata, which at the southern end of the cliff are thin-bedded, hard, brown, magnesian

limestones, but at the northern end are represented by firm, coarsely-crystalline dolomite, in heavy beds which contain much calcite. The entire substage is barren. At the next exposure northward the Schizophoria zone is absent.

This is the first point north of Nora Springs where a full section of the Mason City substage is available. The beds are more or less dolomitized and show a tendency to lose their lithologic distinctness, although enough fossils are known to permit separation of the zones. The uppermost division, the Lepidocentrus zone, is represented by some 40 inches of soft, fine-grained magnesian limestone which apparently represents but one zonule. The unconformity at the upper surface of the zone is pronounced; at the southern end of the cliff the base is marked by a strong bedding plane which becomes weak and obscure northward. The Trigonotreta zone is lithologically like the Lepidocentrus, and except for unrecognizable masses of calcite appears unfossiliferous.

The Aulopora zone is very well represented here, and is separated by an unconformity from the overlying Trigonotreta beds. This unconformity becomes less marked to the north and apparently is absent in the next phase. This zone here consists of two distinct zonules; the upper and by far the greater portion is composed of 9 feet of soft, buff, fine-grained magnesian limestone which is indefinitely bedded at the southern end of the cliff and virtually unstratified at the northern end. It is abundantly fossiliferous, the most common form being an undetermined *Craspedophyllum* whose colonies, sometimes crowded, often attain a thickness of 2 feet and a diameter of 7 feet. This coral is common in the equivalent horizon at Nora Springs, but in much smaller masses. With it here are found many brachiopods and molluscs similar to those of the Nora Springs phase. This member is termed the Craspedophyllum zonule.

The lower member of the Aulopora zone in this phase consists of dolomite, gray to nearly black in color, underlain by gritty magnesian shale which extends beneath water level. These beds are barren, but apparently are equivalent to the Dolomite zonule of the southern phases.

The thickness of the Nora substage in this phase is 14 feet; of the Rock Grove 8 feet; and of the Mason City, 25 feet. For the first two, these are the minimum thickness in the northern phases, while the Mason City, with its full thickness not known, exceeds by 3 feet its thickness at Nora Springs.

11—KEIDLE BLUFF PHASE

From the northern end of Sherman bluff to the next exposure is less than a quarter of a mile. This exposure is locally known as Vermilya's Bluff and is well figured by Calvin.[22] The lower portion of the bluff is composed of beds which show almost no traces of stratification. These beds range from the Craspedophyllum zonule to the base of the upper Actinostroma zone, the horizons being distinguishable at the northern end of the bluff, where they form a series of shelves. On the opposite bank, and slightly north of Vermilya's bluff is a series of undercut cliffs, known as Weitsie's Bluff, which extend nearly to the northern border of section 35. About half of the Craspedophyllum zonule is above water level at the northern end of these exposures.

At the south line of section 26, Falls township, the beds again are exposed on the east side of the river, in a series of low cliffs which show nearly the entire thickness of the Shellrock. This exposure, known as Keidle's Bluff, also is figured by Calvin.[23] The Mason City beds are clearly shown in the figure, comprising the lower half of the section, which appears as a talus slope, although the beds are indurated; their appearance being caused by the rough face of the beds. Above the shattered beds lies the full thickness of the Rock Grove substage as well as the lower Actinostroma zone of the Nora substage. This exposure is located in the southwest quarter of section 26, T. 97 N., R. XIX W.,—not the northwest quarter, as Calvin states.

Throughout the area between Keidle's and Sherman's Bluff the upper Actinostroma zone of the Nora preserves its lithologic and faunal character and can be traced almost con-

22 Iowa Geol. Surv. Vol. 7, p. 129, fig. 14; 1897.
23 Iowa Geol. Surv. Vol. 7, p. 129, fig. 13; 1897.

tinuously. The Playrachella zone is represented by one bed of dolomite which weathers to a gritty shale. The lower Actinostroma zone, as at Sherman's Bluff, is composed of three members, here fossiliferous. The upper and lower zonules contain numerous spheroidal stromatoporoids and a slender idiostromid like that of the Macgeea zonule of the Reed Creek phase. These stromatoporoids increase in size and abundance northward. The strata are much firmer than in the Bjorgason and Sherman Bluff phases and the major bedding planes have become unconformities.

The Rock Grove substage is represented by about 9 feet of uniform, hard, buff dolomite in rather distinct beds representing a northward extension of the Gomphoceras and perhaps the Pterinea zonules of the Paracyclas zone, and apparently barren. Their upper surface bears erosion domes sometimes over a foot in height, while their base is marked by a similar but weaker unconformity.

The Mason City substage is represented by buff, magnesian limestone, largely devoid of stratification. In places, as near the center of the exposure, a portion near the top shows stratification but it intergrades with the beds above and below, and forms no permanent horizon. Calcite forms are abundant as irregular masses and shapeless veins, some of which resemble corals and idiostromids, but rarely are recognizable. Brachiopods are common and easily identified, being of forms which are typical of the Craspedophyllum zonule with which these beds are correlated. Virtually no fossils have been found, but the upper, more stratified portion may be equivalent to the Lepidocentrus and Trigonotreta zones farther south. On the other hand, these zones, particularly the upper, may be absent, represented only by the erosion plane at the top of the substage. This horizon of unstratified buff, magnesian limestone persists from Vermilya's Bluff to Rock Falls, and is characterized by its abundant calcite. In certain places it is more definitely stratified than at Keidle's Bluff, but it cannot be divided.

In the Keidle Bluff phase the Nora substage is 20 feet thick, the Rock Grove 9 feet thick, and the exposed portion

of the Mason City 10 feet, the two upper substages showing a considerable increase over the Sherman Bluff phase.

12—ROCK FALLS PHASE

From the northwest end of Keidle's Bluff the beds dip westward, and the Mason City substage is not shown for nearly a mile. The other two substages are exposed in low cliffs which extend north of Rock Falls, on both banks of the river. In the sections which they offer the zonules of the Rock Grove and Nora may be traced readily.

Through this area the upper Actinostroma zone of the Nora does not change lithologically or faunally though it thins somewhat to the northward. The Platyrachella zone consists of barren dolomites which become rather shaly at Rock Falls. The lower Actinostroma zone consists of three zonules, the upper and lower of which contain abundant spheroidal stromatoporoids and slender idiostromids. At Rock Falls these fossils appear in the central member as well, although the colonies are comparatively scarce and small. The most important change in this zone is lithologic. Slightly west of Keidle's Bluff the uppermost zonule is represented by hard, fine-grained, light buff limestone. This character is sporadically shown at various points to the north. About one-half mile northward the central member shows but a few patches of dolomite in the limestone and so at Rock Falls the lower (first) Actinostroma zone is represented by three beds of hard, light-buff limestone bearing idiostromids and spheroidal stromatoporoids. The central zonule is considerably thickened and all of the zonules are separated by unconformities, the domes of which are sometimes two feet high.

The Rock Grove substage is represented by apparently unfossiliferous dolomites which vary areally in texture, color, and thickness of bedding, but which are everywhere delimited both above and below by very marked unconformities. These represent a northward extension of the Paracyclas zone, probably the Gomphoceras zonule. At Rock Falls they are some 10 feet in thickness and are composed of durable, crystalline dolomite, heavily and rather evenly bedded.

About a mile south of Rock Falls the Mason City beds are brought above water level by a series of small anticlines, and are almost continuously exposed northward to the limits of the town. Both the Craspedophyllum and Dolomite zonules are shown, the latter apparently nearly to its base. The Craspedophyllum zonule contains two apparently permanent layers, separated by unstratified, calcite-bearing beds of the same magnesian character shown at Keidle's Bluff. Northward even these calcitiferous beds become stratified, so that at Rock Falls practically the entire exposed thickness of the substage consists of definitely stratified, magnesian limestone of alternating calcite- and non-calcitiferous character. Fossils are uncommon in the lower portion, but those which have been identified are brachiopods typical of the Craspedophyllum zonule. At Rock Falls the uppermost calcitiferous beds resemble the bed near water level at Parker's Mill in Mason City, while many of the calcite bodies suggest the branching idiostromids found there.

At the exposure nearest Rock Falls the Nora is 22 feet thick, the Rock Grove 10 feet, and the Mason City (exposed) 22 feet, showing increases in the upper two substages.

Northward from Rock Falls the valley of the Shellrock is little more than a narrow trench, with the sodded slopes generally coming down to the banks of the river. Occasionally the Shellrock strata are lifted by small anticlines, through which the river has cut narrow gorges, and in these the upper portions of the Shellrock may be traced well into Worth County.

While no good exposures of the upper Actinostroma and Platyrachella zones of the Nora are offered, small outcrops along road cuts and on slopes well back from the river show that these zones are present to the north, although evidently somewhat thinner. The lower Actinostroma zone, or at least its lower zonules, are shown at most of the gorges along the river, the strata retaining much the character which they show at Rock Falls, although in places some of the beds are dolomitized.

The Rock Grove substage continues to be represented by the Paracyclas zone, which, from the heavy-bedded dolomites shown at Rock Falls, gradually alters to beds of sub-lithographic limestone with layers of dolomite. Such a phase is shown along the west bank of the Shellrock at the site of Foster's Mill, in the northwest quarter of section 29, T. 98 N., R. XIX W., where nearly 20 feet of strata are exposed, a section of which is given by Williams.[24] Here the lowermost zonule of the lower Actinostroma zone is represented by dolomitic limestone containing spheroidal stromatoroids. Beneath this is the Rock Grove beds, the upper few feet of which are dolomite, while the basal portion is a drab, fine-grained limestone of lithographic character. Beds of the Mason City substage are not known to be exposed north of Rock Falls.

The four phases just described show the complete transition of the lower Actinostroma zone from a single bed of laminar stromatoporoids in the Nora Springs phase, to a tripartite limestone zone bearing spheroidal stromatoporoids. The unconformities between the zonules also become marked. The transition of the Paracyclas zone from a shaly limestone to a sublithographic member is also indicated in the exposures east of Manly.

It is this same zone of spheroidal stromatoporoids at Mason City which Calvin[25] correlated with the "Stromatopora Reef" (Pachyphyllum zonule) of Nora Springs. In the immediate vicinity of Mason City (Parker's Mill, Kuppinger quarry, Belding quarry) these stromatoporodal limestones do form the tops of the exposures shown along the streams, and apparently end the section. At various points to the north and west, as well as at Parker's Mill, this zone of spheroidal stromatoporoids is overlain by a horizon of dirty brown, coarsely crystalline dolomite representing the Platyrachella zone; and upon this a zone of limestone bearing laminar stromatoporoids, the upper Actinostroma zone of this paper. The real equivalent of the Nora Springs reef (Pachyphyllum

24 Ia. Geol. Surv. Vol. 10, p. 348; 1900.
25 Ia. Geol. Surv. Vol. 7, pp. 145-146; 1897.

zonule) is represented at Mason City by dolomites, and at Parker's Mill by shales, which occupy a position but a few feet above water level at these points.

To add sections of the Mason City exposures would enlarge this paper unduly. Moreover, the finer relationships of the lower members at Mason City remain uncertain, and must be determined by study of the sections along Lime Creek from Rockford, in Floyd County, to Fertile in Worth County. They will furnish material for another paper.

BOOK REVIEWS

Rehder, Alford, "MANUAL OF CULTIVATED TREES AND SHRUBS HARDY IN NORTH AMERICA."—The Macmillan Co.

Considering conditions in larger cities where it is becoming more and more difficult for students of plants, even in schools to study our native plants, a book such as this becomes not only useful but necessary. There was a time when cultivated plants were not studied as they should be: now they are often the only ones easily obtainable. Moreover it is desirable that we learn more about exotics as not a few become not merely adaptable to our climate, but even naturalized. One could name not a few that in the last generation became naturalized even among the woody plants. The "Manual" seems to be the most complete workable text available for the determination of the woody plants from other lands. The author therefore deserves our thanks for painstakingly working and describing these strangers to our country. It is a poor excuse for a botanist to dismiss a query about our plants of park and greenhouse by saying they are "cultivated" and therefore do not deserve study. Rehder by supplying us with this book, renders the excuse more specious than it ever could have been. Questions of nomenclature have apparently been left purposely to the field of controversy and this is plausible. Some species have been perhaps left out that might have been included but it is no small labor to make a handy volume of reference that contains as many up to date introductions from abroad and other parts of our country without making the volume too unwieldy for beginners. We consider the work as one of the most welcome to our shelves of any in recent years, inasmuch as it is what we surely have been longing for for many years. When much of our information of exotics had to be obtained laboriously and unsatisfactorily from plant and seed catalogues.—J.A.N.

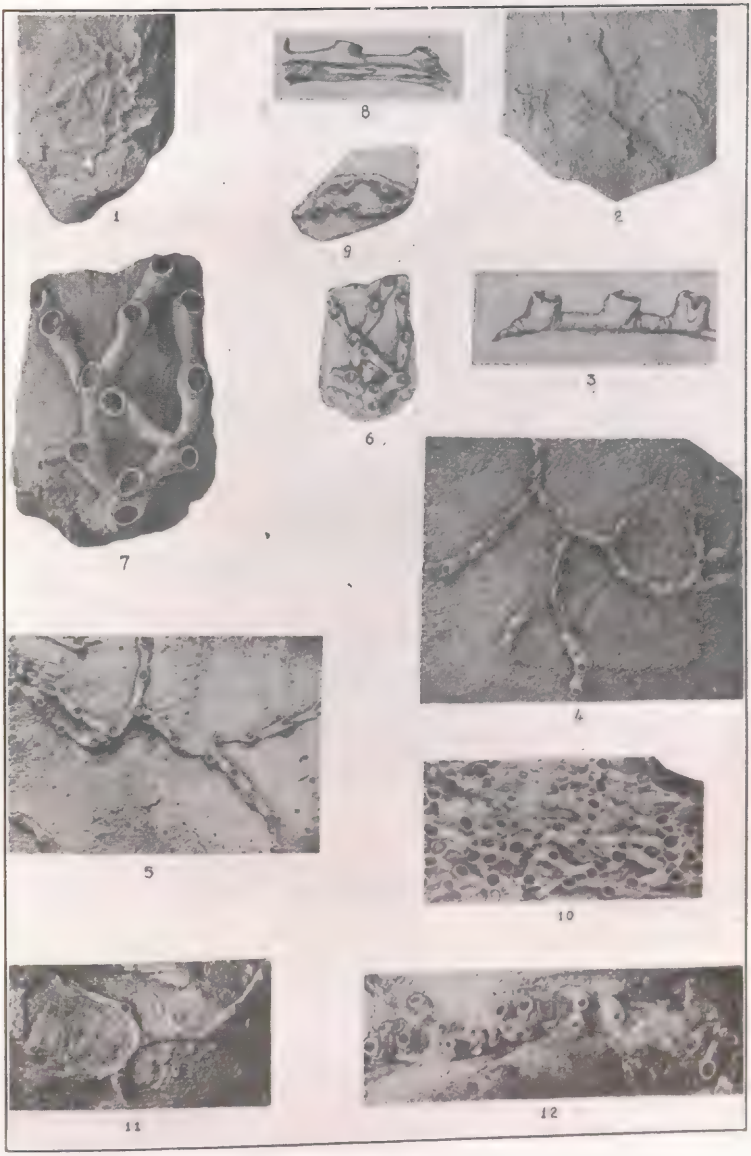


PLATE I.

[See page 383 for explanation.]

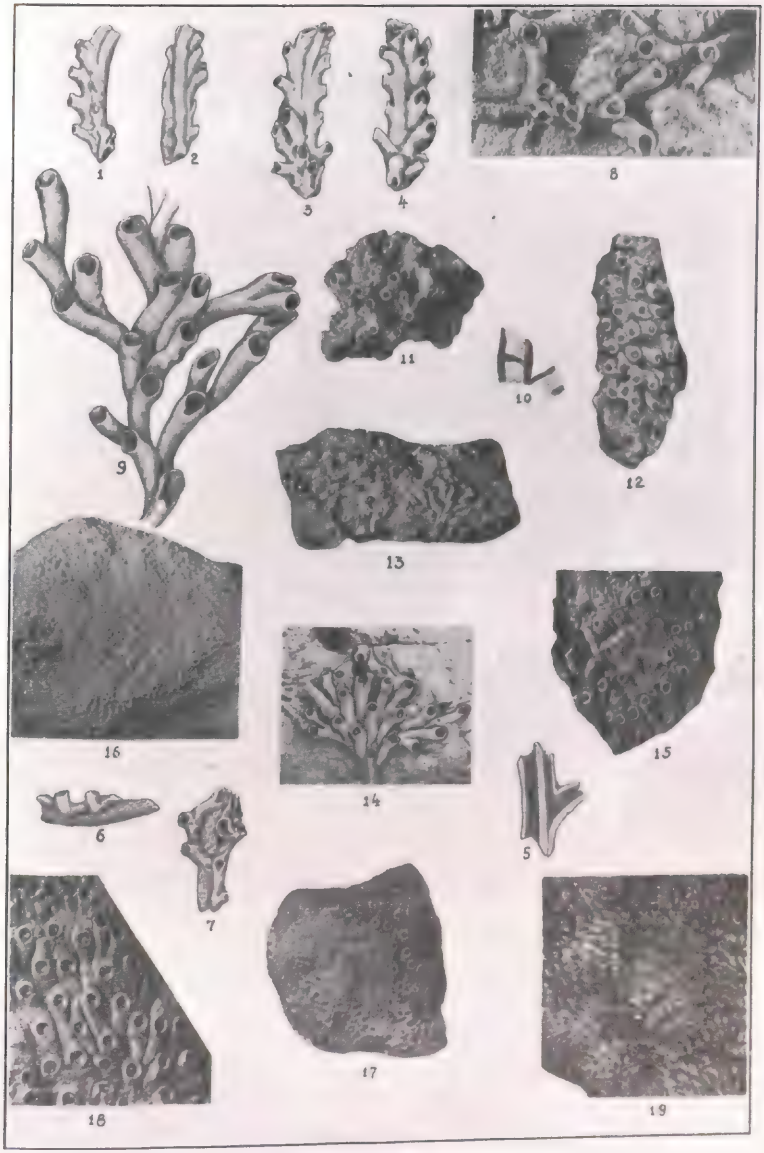


PLATE II.

[See page 384 for explanation.]

The American Midland Naturalist

PUBLISHED BI-MONTHLY BY THE UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA

VOL X. SEPTEMBER-NOVEMBER, 1927. No. 11-12.

NEW SPECIES OF AULOPORA FROM THE DEVONIAN OF IOWA*

By MILDRED ADAMS FENTON.

I.—INTRODUCTION.

Members of the genus *Aulopora* are common in the Hackberry and Shellrock stages of the Devonian of Iowa and are uncommon in a third stage, the Cedar Valley. Those of the Hackberry have been described by Hall and Whitfield** and by Fenton and Fenton,*** but there have been no published accounts of *Aulopora* from the Shellrock and Cedar Valley stages. The purpose of this paper is to provide descriptions of such species from these stages as are now available and in addition, of two apparently new species from the Spirifer zone of the Hackberry. Many of the specimens studied are in the University of Cincinnati Museum, while others remain in the collection of Mr. C. H. Belanski. In addition to lending specimens, Mr. Belanski has provided detailed stratigraphic data for the descriptions.

Although the genus *Aulopora commonly* is placed among the tabulate corals, it seems to differ from the "bryozoan," *Stomatopora* in but one character: large size. More signifi-

* Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 1.

** Ann. Rep. N. Y. State Cab. Nat. Hist. p. 235, pl. 10, figs 5-6. 1873.

*** Stratigraphy and Fauna of the Hackberry Stage, pp. 64-69, pl. 16. 1924. *Aulopora maxima* has proved to be a member of the genus *Ceratopora* Grabau.

cantly, some of the species of *Aulopora* are scarcely distinguishable from large, dry, mud-incrusted specimens of the modern *Plumatella princeps,* a common fresh-water bryozoan. These and other relationships have caused me to doubt the anthozoan nature of *Aulopora;* but because no detailed study has been given the matter, I merely have refrained from using most terms that denote either bryozoan or anthozoan affinities for the genus.

II.—DESCRIPTION.

Aulopora stainbrooki n. sp.

Plate I, Fig. 12.

Description.—Colony prostrate, growing on the surface of a coral. Tubes attached throughout their entire length with the apertures directed obliquely or attached at the point of origin and directed vertically. Dimensions of two tubes: length 7.6 mm. and 6.5 mm.; transverse diameter at the point of origin 2.8 mm.; outside diameter at the aperture 2.5 mm. and 3.8 mm. The tubes show heavy wrinkles; any finer markings were lost in silicification. Apertures are round. Several weathered tubes show longitudinal markings.

Remarks.—The large and heavy tubes suggest that this form may be a Ceratopora but this point can not be determined until sectionable material has been found.

Occurrence.—Common in the "Acervularia davidsoni" beds of the Cedar Valley in the vicinity of Brandon, Iowa.

Holotype.—No. 6016, Collection of C. H. Belanski.

Aulopora multiramosa n. sp.

Plate I, Fig. 1.

Description.—Colony prostrate, branched, and attached to the surface of a stromatoporoid. Dimensions of three tubes: length 2.5 mm., 3.6 mm. and 2.9 mm.; transverse diameter of tube at the point of origin 1 mm., 1.2 mm. and 1.2 mm.; transverse diameter at the base of the tube below the aperture 1.5 mm., 1.6 mm. and 1.5 mm.; outside diameter of the aperture 0.2 mm., 1.1 mm. and 1 mm. The tubes are round and

bifurcate at every cell or every other cell; their surfaces bear fine concentric markings. The apertures are round, have thin walls and are directed vertically or obliquely. No tabulae noted.

Occurrence.—This is a rather uncommon form. It is known only from the Alveolites faunule at "Parker's Mill," Mason City, Iowa.

Holotype.—No. 870, Collection of C. H. Belanski.

Aulopora modulata n. sp.

Plate I, Figs. 5-9.

Description.—Colonies branched, attached to surfaces of *Schizophoria,* stromatoporoids and corals. The tubes are small at the point of origin; enlarging gradually and turning upward in the latter third of the tube. The apertures are directed either obliquely or vertically, depending upon the height to which the tubes rise. Dimensions of three tubes; length 5.2 mm., 5.5 mm. and 5 mm.; transverse diameter at the point of origin 1.4 mm., 1.2 mm. and 1 mm.; transverse diameter at the base of the ascending portion of the tube 2.2 mm., 1.6 mm. and 2.2 mm.; outside diameter at the aperture 1.8 mm., 1.5 mm. and 1.6 mm.; greatest height 1.5 mm., 1.4 mm. and 1.6 mm. Tubes are finely wrinkled. One specimen shows one tabula.

Occurrence.—This species is common throughout the Schizophoria zone of the Rock Grove substage as well as in several of the members of the Nora substage. In general the tubes of the forms found in the Rock Grove beds are somewhat shorter and slightly more robust than those found in the Nora substage.

Holotype.—No. 1045; *Paratypes.*—Nos. 175, 1904, 2060, 2061, 2063, Collection of C. Belanski, Nos. 2034, 2035, University of Cincinnati.

Aulopora noraensis n. sp.

Plate I, Fig. 5; Plate II, Figs. 8-10.

Description.—Colonies branched, prostrate, attached to surfaces of stromatoporoids and corals. Dimensions: tubes

2.6 to 5.9 mm. in length, those of the holotype ranging from 4.1 to 4.6 mm.; transverse diameter (in the holotype) 1.4 to 1.6 mm.

The tubes maintain approximately the same diameter throughout their length, and bifurcate at every cell or every other cell. The apertures are round, slightly constricted, and open either obliquely or vertically. The tubes of well preserved specimens are marked by fine wrinkles, which are absent in poorly preserved material. Usually there is one tabula present in each tube, as is shown in Plate II, Fig. 10.

Remarks.—This form is highly variable in the manner of its growth, since this largely is controlled by the nature of the host. It is one of the commonest *Auloporas* of the Mason City substage.

Occurrence.—Particularly common in the Aulopora zone, especially in the Pachyphyllum zonule at Nora Springs. It occasionally is found in the Alveolites zonule at Mason City, and less often in the Craspedophyllum beds.

Holotype.—No. 2025; *Paratypes.*—Nos. 2026, 2027 and 2039, University of Cincinnati, and No. 115, Collection of C. H. Belanski.

Aulopora irregularis n. sp.

Plate II, Figs. 11-12.

Description.—Colonies irregularly massive or incrusting; attached to *Alveolites* and stromatoporoids. Dimensions: tubes 3 to 5 mm. in length, and 1.4 to 2.2 mm. in diameter. Apertures round, generally without constriction, and characteristically are directed vertically. Bifurcation commonly takes place at every cell, but the massed tubes, growing against and upon each other, make regularity impossible.

Remarks.—Several specimens, growing on stromatoporoids, have thick walls with marked growth wrinkles; in a few cases the erect portion of the tube reaches a greater height than is characteristic. The heavy-walled character is shown in Fig. 12, Plate I. A specimen from the Alveolites zone with

short tubes and heavy walls is doubtfully referred to this species.

Occurrence.—Aulopora zone; particularly common in the Pachyphyllum zonule at Nora Springs.

Holotype.—No. 2028; *Allotype* No. 2029, University of Cincinnati; *Paratypes.*—Nos. 708, 950, and 1128, Collection of C. H. Belanski.

Aulopora munda n. sp.

Plate II, Figs. 12-14.

Description.—Colonies palmately incrusting; attached to corals and stromatoporoids. Dimensions, of one tube in each of three specimens: length 3.4 mm., 4.7 mm. and 2.1 mm.; greatest diameter 1.4 mm., 0.8 mm. and 1.0 mm.; outside diameter at the aperture 0.7 mm., 0.7 mm. and 0.5 mm.

The tubes are either crowded or spread in a fan-like arrangement; the two types being portrayed by Figs. 13 and 14 of Plate II, respectively. The tubes remain distinct even though they are so closely crowded that they conceal the surface of the host; the tubes found in the fan-like arrangement are more distinct than those in the other type of growth. Tubes bud at the mid-length of the parent cells or at the anterior portion where the tubes are directed upward. One to three tubes bud from each parent cell. The tubes bear fine transverse markings.

Occurrence.—Rather uncommon in the Alveolites zonule at Mason City; uncommon in the Pachyphyllum zonule at Nora Springs.

Holotype.—No. 2031, University of Cincinnati; *Allotype* —No. 244, Collection of C. H. Belanski; *Paratype.*—No. 2032, University of Cincinnati.

Aulopora crebriformis n. sp.

Plate II, Figs. 17-18.

Description.—Colonies incrusting the surfaces of other organisms, particularly stromatoporoids. Dimensions: tubes 2

to 4.7 mm. in length, the average being 3.2 mm., and 1.7 to 1.9 mm. in transverse diameter; apertures 0.6 to 0.9 mm. in diameter.

The tubes are small at their origin, increasing in diameter toward the aperture. They are flattened and coalesced along their sides, so that in most specimens they entirely conceal the surface of the host. One, two or even three tubes are given off from each parent one. The apertures are round or slightly oval, are constricted, and are directed vertically even though they rise but little above the general surface of the tube.

Remarks.—This species resembles *Aulopora incrustans* F. and F., of the Hackberry stage, but differs from it in the greater length and width of its tubes, its larger and proportionately less elevated apertures, and somewhat more regular manner of growth. These differences, while not great, are constant in all specimens examined, and afford ready means of identification. For comparison with *Aulopora crebriformis*, a portion of the holotype of *A. incrustans* is illustrated on Plate II, Fig. 19.

Occurrence.—Very common in the Lepidocentrus zone, but particularly so in the Camarophoria zonule at Nora Springs. Uncommon in the Prismatophyllum zonule at Rudd and in the Macgeea zonule to the north of Nora Springs. The types are from the Camarophoria beds.

Holotype.—No. 2022; *Paratypes.*—Nos. 2023 and 2024, University of Cincinnati.

Aulopora jugalis n. sp.

Plate II, Fig. 16.

Description.—Colonies incrusting surfaces of stromatoporoids. Dimensions: length of tubes 2.2 to 3.3 mm.; outside diameter of aperture approximately 1 mm.; apertures number 5 to 7 in the space of 10 mm., being very closely spaced.

The tubes are short and not very distinct; their walls coalesce so that they entirely hide the surface of the host. One or two tubes arise from each parent tube. The apertures are

round and scarcely rise above the genral surface of the tubes, which are delicate and poorly preserved. No tabule seen.

Remarks.—This form differs from *Aulopora incrustans* F. and F., of the Hackberry stage, (Plate II, Fig. 19), in having less distinct tubes which bear no wrinkles, heavier walls, and in having vertically directed and abruptly expanded apertures. It is separated from *Aulopora crebriformis* by its smaller size, proportionately shorter and less distinct tubes, and in the absence of marked constriction at the apertures.

Occurrence.—Confined to the Aulopora zone. It is especially common in the Alveolites zonule at Mason City.

Holotype.—No. 270; *Paratypes.*—No. 286, Collection of C. H. Belanski, and No. 2040, University of Cincinnati.

Aulopora linearis n. sp.

Plate I, Fig. 10.

Description.—Colonies prostrate, attached to surfaces of other organisms or to indurated sediments. Dimensions of two typical tubes: length, including the aperture, 6 mm. and 7.3 mm.; transverse diameter at point or origin 1.7 mm. and 1.4 mm.; transverse diameter just posterior to the aperture 1.9 mm. in both; outside diameter of the aperture 2.9 mm. and 2.1 mm.; height of aperture above the base of attachment 1 mm.

When well preserved, the aperture is round; where not, it is oval. In a few examples in which the tubes are closely crowded it is polygonal. Evidence of tabulae appears only in weathered tubes, in which the tabulae appear to have numbered one or two, and to have passed directly across the tubes. Well preserved specimens show fine wrinkles, which are not visible in the figure.

Remarks.—Though this form resembles *Aulopora expansa* F. and F.* of the Owen substage of the Hackberry, it differs

* Stratigraphy and Fauna of the Hackberry Stage, p. 67, pl. 16, fig. 10. 1924.

from it in manner of growth. Unlike *A. expansa*, *A. linearis* does not branch out over the surface to which it is attached, but instead grows in linear series. At intervals the tubes are irregularly crowded but their general trend is in one direction.

Occurrence.—Confined to the Lepidocentrus zone at Nora Springs where the colonies are found attached to stromatoporoids and indurated sediments at the top of the Camarophoria zonule.

Holotype.—(in three parts) Nos. 1943, 2065, Collection of C. H. Belanski and 2021, University of Cincinnati.

Aulopora elongata n. sp.

Plate I, Fig. 11.

Description.—Colonies prostrate, attached, branching. Dimensions of one tube: length 7.5 mm.; transverse diameter at point of origin 1 mm.; outside diameter of aperture 2 mm.; height of aperture above base of attachment, 1.3 mm.

The tubes are long, small at their point of origin, and enlarge gradually toward the aperture. The branches bifurcate at wide angles. A few tubes bear fine wrinkles, but no tabulae have been seen.

Remarks.—This species is based on a single poor specimen. Its characters, particularly of length and diameter of tubes, are so unusual, however, that there seems no ground for referring it to any other species, or for doubting that other specimens of the same form may be identified.

Occurence.—Confined to the Camarophoria zonule at Nora Springs, where the tubes are attached to indurated sediments at the upper surface of the bed.

Holotype.—No. 848, Collection of C. H. Belanski.

Aulopora confluens n. sp.

Plate I, Figs. 1-7.

Description.—Colonies consist of confluent, longitudinal, and apparently vertical series of tubes. All of the specimens

studied are fragmentary, one (the holotype), measuring 12 mm. in length. Dimensions: length of tubes 3 to 3.5 mm.; transverse diameter 0.7 to 0.9 mm.; outside diameter of aperture 0.7 to 0.9 mm.

Instead of being prostrate and attached, as is the common case in Aulopora, the series of tubes in this species are attached only to each other, and the resulting columns seem to have grown erect. The two specimens illustrated in Figs. 1 to 4 of Plate II each have three series of tubes; each tube is distinct and gives rise to a new one whose diameter at the point of origin is nearly as great as that of the parent. The surfaces are either smooth or finely wrinkled; the apertures are oblique, and the confluence of the tube-series rarely obscures the boundaries of each.

Remarks.—A third specimen, doubtfully referred to *A. confluens*, is illustrated in Figs. 6 and 7 of Plate II. In general size and character the tubes resemble those of the holotype, but they are somewhat more distinct, and are attached to a fragment (not rolled or worn) of *Orthopora ulrichi* F. and F. It seems probable that we have here the base of such columnar growths as are shown in Figs. 1 to 4.

Occurrence.—Pugnoides zonule, near the top of the Cerro Gordo substage of the Hackberry. It is found chiefly in the vicinity of Bird Hill and rarely at Hackberry Grove.

Holotype.—No. 3892; *Paratypes.*—Nos. 3670, Collection of C. H. Belanski; Nos. 2036, 2037 and 2038, University of Cincinnati.

Aulopora delicata n. sp.

Plate I, Figs. 2-4.

Description.—Colony dichotomously branched, prostrate, attached to the surface of a stromatoporoid. Dimensions: length of a tube 1.6 mm.; transverse diameter at the point of origin 0.7 mm.; outside diameter at the aperture 0.7 mm.; height of tube above the base of attachment 1 mm.

As is indicated by the dimensions, the tubes retain virtually the same transverse diameter throughout their length, although a few tubes show slight construction toward the apertures. These are round, and are directed either vertically or slightly obliquely. The walls are without marking, and no trace of tabulae has been found.

Occurrence.—The one specimen upon which the species is based was found in beds of Cerro Gordo age about one mile northwest of Juniper Hill. Its exact horizon is doubtful but probably is the Heliophyllum zonule.

Holotype.—No. 2033, University of Cincinnati.

EXPLANATION OF PLATE I.

FIGURE PAGE

1. *Aulopora multiramosa*, n. sp. ---------- 374
   Holotype (870 C.H.B.), x 1.

2—4. *Aulopora delicata*, n. sp. ---------- 381
   2. Holotype (2033 U.C.M.), x 1.
   3. Enlargement of the first three cells of the colony. x 8.
   4. Enlargement of the holotype. The position is reversed to better show the character of the species, x 2.

5—9. *Aulopora modulata*, n. sp. ---------- 375
   5. Holotype (1045 C.H.B.), x 1.
   6. Paratype (1904 C.H.B.), x 1.
   7. Same, x 2.
   8. Two cells of Fig. 7. x 2.
   9. Paratype (2060 C.H.B.), x 1.

10. *Aulopora linearis*, n. sp. ---------- 379
    Holotype (1943 C.H.B.), x 1.

11. *Aulopora elongata*, n. sp. ---------- 380
    Holotype (848 C.H.B.), x 1.

12. *Aulopora stainbrooki*, n. sp. ---------- 374
    Holotype (6016 C.H.B.), x 1.

EXPLANATION OF PLATE II.

FIGURE — PAGE

1—7. *Aulopora confluens*, n. sp. ---------- 380

1. Paratype showing mode of growth (3670 C.H.B.), x 2.

2. Another view of the same, showing the reverse side, x 2.

3—4. Two views of the holotype (3892 C.H.B.), x 2.

5. Longitudinal section through a colony (2037 U.C.M.), x 4.

6—7. Two views of an adnate colony that probably represents the attachment of A. *confluens*. Paratype (2036 U.C.M.), x 2.

8—10. *Aulopora noraensis*, n. sp. ---------- 375

8. Holotype, attached to the surface of a stromatoporoid (2025 U.C.M.), x 2.

9. A colony growing about an idiostromid. The drawing shows the specimen unrolled. Paratype (2026 U.C.M.), x 2.

10. Longitudinal section through two tubes showing the position of a tabula in one. (2039 U.C.M.), x 5.

11—12. *Aulopora irregularis* n. sp. ---------- 376

11. Colony of tubes growing over each other. Holotype (2028 U.C.M.), x 1.

12. Colony attached to an idiostromid. Paratype (708 C.H.B.), x 1.

13—15. *Aulopora munda* n. sp. ---------- 377

13. Two colonies of this form attached to an idiostromid. Holotype (2031 U.C.M.), x 1.

14. Right-hand colony of Fig. 13 enlarged to show the fanlike arrangement of the tubes, x 2.

15. Allotype, showing the cells crowded together but not in fanlike arrangement (244 C.H.B.), x 2.

16. *Aulopora jugalis*, n. sp. ---------- 378

A colony with the tubes entirely covering the surface of a stromatroporoid. Holotype (270 C.H.B.), x 1.

17—18. *Aulopora crebriformis*, n. sp. ---------- 377

17. Holotype, incrusting the surface of a stromatoporoid (2022 U.C.M.), x 1.

18. The same, enlarged, x 2.

19. *Aulopora incrustans*, F. and F. ---------- 379

A portion of the holotype, introduced for comparison with Figs. 15 and 16. Holotype (8091 Univ. of Mich.), x 1.

THE SPECIES OF POLYGONATUM.

By BENJAMIN FRANKLIN BUSH

From my earliest acquaintance with the Solomon's Seals, I was mystified with the species names, and descriptions, no two authors agreeing as to the names and range of the species, and most of them differing in different editions of their manuals and floras.

I did finally conclude in 1900 that in the West here, we had a species that seemed by general consent to be *P. commutatum*, while in the East there was something or some species that no one understood or knew anything about. This opinion of mine is found in the Manual of the Flora of Jackson County, Missouri, which was published in 1902.

After the publication of the Manual, I put the whole matter of the species of POLYGONATUM into the pile of unsolved problems, and it remained there until I saw Farwell's paper on the Michigan species of Plygonatum.[1] This paper of Farwell's which presented five species and six varieties, threw some light on hitherto obscure places, and made more obscure some things already too dark for me.

Having no herbarium material in hand to examine, I could only observe and study the plants that grew here in Western Missouri, and I was soon convinced that we had three of the species, varieties or forms given by Farwell, which could be distinguished without much effort. Of the remaining eight species and varieties given by Farwell, they were entirely unknown to me, although it began to look to me that he was more than a little right about some of them.

Matters remained about thus until in the spring of 1917, when Gates published his Revision of the genus POLYGONATUM,[2] in which he recognized nine species and five varieties, accepting all of Farwell's species and varieties excepting *P.*

1 Bull Torr. Club *42;* May, 1915.
2 Bull. Torrey Club *44;* March, 1917.

boreale, which he reduced to *P. pubescens*, and presenting five species not mentioned by Farwell. This paper of Gates' was a long step in advance of Farwell's, and satisfactorily disposed of several species that Farwell brought out only to make still more obscure, namely: *P. biflorum* (Walt.) Ell., *P. biflorum hebetifolium Gates*, *P. commutatum virginicum* (Greene) Gates, and *P. commutatum ovatum* (Farwell) Gates.

I have examined several hundred sheets of specimens of POLYGONATUM from Indiana, many from Illinois, Missouri, Iowa, Michigan, Minnesota, New Jersey, Massachusetts, New York, Ohio and nearly all the States in New England, and I have come to these conclusions: first, that Farwell's list of five species and six varieties must be reduced to seven, as four of his names must be referred to two of his other species. Secondly, Gates' list of nine species and five varieties must be reduced to ten, and more study of the species and better collections may reduce this number still further.

My conception of the species of POLYGONATUM is therefore quite at variance with both Farwell and Gates, both as to the identity of the species themselves, and the range of some of them. I have seen nearly all of Farwell's specimens, including the type material of all of his new species and varieties, for the loan of which I am under many obligations. I am also under many obligations to Prof. William Trelease, Mr. Charles C. Deam and Mr. Kenneth K. Mackenzie, for the loan of all their material to study, to whom I hereby return thanks.

1. POLYGONATUM PUBESCENS (Willd.) Pursh, Fl. Am. Sept. 23, 1814.

Convallaria pubescens Willd. Hort. Berol 45, pl. 45, 1805.

Polygonatum multiflorum Americanum Hook Fl. Bor. Am. *1*: 176, 1840, in part.

? *Convallaria hirta* Bosc; Poiret, Encyc., *4*: 369. 1796.

? *Polygonatum hirtum* (Bosc) Pursh, Fl. Am. Sept. 234. 1814.

Polygonatum biflorum A. Gray, Man Ed 2, 466, 1856, not *Convallaria biflora* Walter, 1788.

Salomonia biflora Farwell, Rep. Com. Parks, Detroit *11*: 53. 1900; not *Convallaria biflora* Walter 1788, as to synonymy, not as to specimens.

Polygonatum biflorum Am. authors, in large part, not *P. biflorum* (Walt.) Elliott, 1817.

"Polygonatum hirtum" Gates, l.c., very probably the same as *P. pubescens Pursh,* which, if proven to be the same, must hereafter be known as P. HIRTUM (Bosc) Pursh.

TYPE LOCALITY: North America.

Michigan, Massachusetts and New Jersey, according to Farwell l.c. 253, 1915, but some or all these localities may be based on specimens of *P. boreale,* which Farwell did not distinguish from *P. pubescens* in the herbarium at the time he published his paper. The figure on plate 12, of his paper very clearly illustrates this distinct species, but the figure on Plate 13, A, undoubtedly represents *P. boreale.*

Massachusetts, North Carolina, South Carolina, Wisconsin, Michigan, Connecticut, New Jersey, Pennsylvonia, Virginia, Indiana and Minnesota, according to Gates, l.c., 118, 1917, but some or nearly all of these localities must be based on specimens of *P. boreale* which Gates did not accept, being misled by Farwell, but I think *boreale* is distinct enough to recognize as a species.

SPECIMENS EXAMINED:

MICHIGAN:

Biological Station, *Deam* 28720, July 12, 1919 D. Herb.; this is the only collection seen from Michigan, all others, including Farwell's specimens, being *P. boreale.*

NEW JERSEY:

Greenwood Lake, *Mackenzie* 2574, May 19, 1907, M. Herb.

MAINE:

Orono, *Knight,* May 28, 1905, M. Herb.

INDIANA:

Vernon, *Deam* 24745, May 14, 1918, D. Herb.

2. POLYGONATUM BOREALE Greene, Leaflets, *1*: 181. 1906. *Salomonia biflora* Farwell, in part, Rep. Com. Parks Detroit II: 53. 1900, not *Convallaria biflora* Walter, 1788.

Polygonatum biflorum American authors, in part, not *P. biflorum* (Walt.) Elliott, 1817.

Polygonatum boreale australe Farwell, Bull. Torr. Club *42*: 254. 1915.

Polygonatum pubescens Farwell, in part, as to specimens, and specimens cited, not *P. pubescens* (Willd.) Pursh, 1814.

Polygonatum pubescens Gates, in part, as to specimens and synonymy, not *P. pubescens* (Willd.) Pursh, 1814.

TYPE LOCALITY: Winona, Minnesota.

Michigan, and Minnesota, according to Farwell, the latter locality taken from Greene, l.c. 181, 1906.

No localities cited for this species by Gates, who being misled by Farwell as to the identity of the true *P. pubescens*, did not distinguish this species from that.

SPECIMENS EXAMINED:

MINNESOTA:

Little Pine Lake, Ottertail County, *Chandonnet*, May 30, 1910, M. Herb.

MICHIGAN:

Lake Harbor, *Umbach*, May 28, U. of Ill. Herb.; Montgomery County, *Deam* 12779, May 16, 1913, D. Herb.

INDIANA:

Carmel, *Deam* 12677, May 11, 1913, D. Herb.; Chestnut Ridge, *Deam* 5658, April 25, 1910, D. Herb.; Eaton, *Deam* 23128, May 25, 1917, D. Herb.; Fort Wayne, *Deam* 15832, May 31, 1915, D. Herb.; Garrett, *Deam* 3084, May 17, 1908, D. Herb.; Goshen, *Deam* 19576, May 11, 1916, D. Herb.; Greentown, *Deam* 5947, May 15, 1910, D. Herb.; Juliett, *Deam* 10509, May 14, 1912, D. Herb.; Kendallville, *Deam* 15848, June 6, 1915, D. Herb.; Lafayette, *Deam*, May 5, 1900, D. Herb.; Marion, *Deam* 19799, May 23, 1916, D. Herb.; Marion County, *Deam*, April 30, 1905, D. Herb.; McGaugh-

ey's, *Deam*, 13479, June 29, 1913, D. Herb.; Medora, *Deam*, 24778, May 15, 1918, D. Herb.; Michigan City, *Deam* 6427, May 22, 1910, D. Herb.; Mongo, *Deam* 15702, May 17, 1915, D. Herb.; Rome City, *Deam* 6780, June 20, 1910, D. Herb.; Saint Joe, *Deam* 20849, August 17, 1916, D. Herb.; South Bend, *Deam* 19540, May 10, 1916, D. Herb.; Stroh, *Deam* 15957, June 5, 1915, D. Herb.; Stroh, *Deam* 15948, June 5, 1915, D. Herb.; Unionport, *Deam* 19678, May 16, 1916, D. Herb.; Upland, *Deam* 15801, May 22, 1915, D. Herb.; Vernon, *Deam* 24745, May 14, 1918, D. Herb.

NEW HAMPSHIRE:

Hanover, *Hitchcock*, May 25, 1903, U. of Ill. Herb.

OHIO:

Parma, *Ashcroft*, June 1885, U. of Ill. Herb.

MAINE:

South Chesterville, *L. O. E.* May 20, 1899, U. of Ill. Herb.

MASSACHUSETTS:

Russell, *Rusby*, May 31, 1873, P. D. & Co. Herb. This specimen is cited by Farwell, l.c. 253 1915, as typical *P. pubescens*, but it is not that species; Williamstown, *Nason*, May, year not given, U. of Ill. Herb.

NEW JERSEY:

Boonton, *Trelease*, month not given, 1913, U. of Ill. Herb.; Franklin County, *Rusby*, August, 1879, P. D. & Co. Herb. This specimen is also cited by Farwell, l.c. 253, 1915, as typical *P. pubescens*, but it has nothing to do with that species. This specimen and the Rusby specimen cited above from Massachusetts are labeled *P. biflorum*, but the name *biflorum* is crossed out on both labels with pencil and the name *pubescens* written on the labels by Farwell.

3. POLYGONATUM CUNEATUM Greene, Leaflets, *1*: 171. 1906.

Polygonatum pubescens cuneatum (Greene) Farwell, Bull. Torrey Club *42*: 253. 1915.

Stems terete, 4-5 dm. tall or less, 2-4 mm. in diameter; leaves on the stem nine to thirteen, elliptical, lanceolate or

ovate-lanceolate, or narrowed at the base, amplexicaul, subsessile, or short-petioled, green above, pubescent on the nerves below, 18-35 mm. wide by 6-12 cm. long; three to seven of the nerves more or less prominent; peduncles short, about 12 mm. long, one-or two-flowered; pedicels shorter than the peduncles; flowers 8-10 mm. long, 2-3 mm. thick, occasionally sessile, the cylindrical tube yellowish-white, or white in dry specimens; filaments filiform, papillate, the free part shorter than the anthers; mature fruit globular, 8-10 mm. in diameter; seeds three to nine, 4 mm. wide.

TYPE LOCALITY: Turin, Marquette County, Michigan.

Michigan, according to Farwell, who misunderstanding *P. pubescens*, made this species a variety of that species, but evidently intending to place it under *P. boreale*, as his reference of Rusby's specimens of *P. boreale*, to *P. pubescens* easily proves. It has nothing to do with *P. pubescens*.

Connecticut, Pennsylvania and Michigan, according to Gates, who made the same mistake of placing this under *P. pubescens*, following Farwell.

SPECIMENS EXAMINED:

INDIANA:

Fort Wayne, *Deam* 15832, May 31, 1915, D. Herb.; Lynn, *Deam* 19693, May 16, 1916, D. Herb.; Turkey Run, *Deam* 9917, September 2, 1911, D. Herb.; Wells County, *Deam*, May 16, 1897, D. Herb.

4. POLYGONATUM FARWELLII B. F. Bush, n. sp.

P. boreale multiflorum Farwell, Mich. Acad. Sci. Rept. *20*: 170. 1918, not *Convallaria multiflora* L. 1753.

TYPE LOCALITY: Walled Lake, Michigan.

Stems 8-12 dm. tall, with 14-16 leaves; leaves 7-10 cm. long, 3-4 cm. wide, with 7-9 principal veins, ovate, lanceolate or elliptical lanceolate, tapering to each end, blunt at apex, closely and short pubescent on the secondary veins beneath; peduncles short, 1-2 cm. long, the upper 2-flowered, the lower 3-4-flowered; flowers greenish, 8-10 mm. long, and 2 mm.

thick. Differs from *P. pubescens* and *P. boreale*, in the much larger, more numerous leaves, larger flowers and longer peduncles.

This is certainly very distinct from *P. boreale*, Greene, which is very common in northern Indiana and Michigan. The Yuncker collection exactly matches Farwell's type specimens.

SPECIMENS EXAMINED:

MICHIGAN:

Walled Lake, *Farwell* and *Chandler* 4488, June 15, 1917, TYPE, P. D. & Co. Herb.; Haslet, *Yuncker* 261, June 17, 1917, U. of Ill. Herb.

5. POLYGONATUM BIFLORUM (Walt.) Elliott, Bot. S. Car. & Ga. *1*s 393. 1817.

Conv allaria biflora Walt. Fl. Car. 122. 1788.

Polygonatum angustifolium Pursh, Fl. Am. Sept. 234, 1914.

Convalloria angustifolia (Pursh) Schult. Syst *7*: 301, 1829.

Polygonatum multiflorum b *americanum* Hook. Fl. Bor. Am. *2*: 176. 1840, in part.

TYPE LOCALITY: Southeastern United States.

North Carolina, South Carolina and (doubtfully) Pennsylvania, according to Gates.

Atlantic seaboard, according to Farwell, but the specimen cited and on Pl. 15, fig. A., represents another species.

6. POLYGONATUM HEBETIFOLIUM (Gates) B. F Bush.

P. biflorum Farwell, Bull. Torr. Club *42*s 254. Pl. 15, fig. A, 1915, not *P. biflorum* (Walt.) Elliott, 1817.

TYPE LOCALITY: North Carolina.

New York, New Jersey, Pennsylvania, District of Columbia, Kentucky and North Carolina, according to Gates, l.c. 121, 1917.

SPECIMENS EXAMINED:

GEORGIA:

Thompson, *Bartlett* 1713, August 9, 1909, M. Herb.

CONNECTICUT:

Fairfield, *Eames*, June 12, 1896, M. Herb.

NEW JERSEY:

Boonton, *Trelease*, month not given, 1913, U. of Ill. Herb.; Chatham, *Mackenzie* 189, May 30, 1903, M. Herb.; Cranberry Lake, *Mackenzie* 2596, June 9, 1907, M. Herb.; Franklin, *Rusby*, July 1875, P. D. & Co. Herb. This is the plant taken by Farwell for *P. biflorum* and illustrated on Plate 15, A, Bull. Torr. Club, *42*: 1915.

DISTRICT OF COLUMBIA:

Chevy Chase, *Chase*, May 25, 1904, U. of Ill. Herb.

ILLINOIS:

Urbana, *Clinton*, May 27, 1900, U. of Ill. Herb.

TENNESSEE:

Lookout Mountain, *Schneck*, May 10, 1901, U. of Ill. Herb.

MARYLAND:

Sligo, *Chase*, May 18, 1905, U. of Ill. Herb.

INDIANA:

Chestnut Ridge, *Deam* 12720, May 11, 1913, D. Herb.; Clark County, *Deam* 5864, May 11, 1910, D. Herb.; Corydon, *Deam* 23384, June 3, 1917, D. Herb.; Cross Plains, *Deam* 16141, June 19, 1915, D. Herb.; Elizabeth, *Deam* 27887, June 11, 1919, D. Herb.; Evansville, *Deam* 16766, July 2, 1915, D. Herb.; Harrodsburg, *Deam* 25573, June 9, 1917, D. Herb.; Helmsburg, *Deam* 5983, May 21, 1910, D. Herb.; Huntingburg, *Deam* 27234, May 4, 1919, D. Herb.; Huntingburg, *Deam* 27239, May 4, 1919, D. Herb.; Lexington, *Deam* 27585, May 20, 1919, D. Herb.; Loogootee, *Deam* 17140, July 10, 1915, D. Herb.; Medora, *Deam* 24773, May 15, 1918, D. Herb ; Milltown, *Deam* 16434, June 25, 1915, D. Herb.;

Mitchell, *Deam* 17282, July 12, 1915, D. Herb.; Mitchell, *Deam* 23525, June 8, 1917, D. Herb.; Mitchell, *Deam* 23558, June 8, 1917, D. Herb.; Morris, *Deam* 10566, May 19, 1912, D. Herb.; New Albany, *Deam* 15308, June 23, 1915, D. Herb.; Newberry, *Deam* 25659, July 3, 1918, D. Herb.; Newberry, *Deam* 25335, June 11, 1918, D. Herb.; Palmyra, *Deam* 23424, June 4, 1917, D. Herb.; Princeton, *Deam* 25532, June 30, 1918, D. Herb.; Robinson Park, *Deam* 1054, June 3, 1906, D. Herb.; Shoals, *Deam* 12875, May 20, 1913, D. Herb.; Stanford, *Deam* 26072A, August 8, 1918, D. Herb.; Sunman, *Deam* 27561, May 19, 1919, D. Herb.; Troy, *Deam* 16657, June 30, 1915, D. Herb.; Tunnelton, *Deam* 24844, May 17, 1918, D. Herb.; Yankeetown, *Deam*, 25329, June 11, 1918, D. Herb.

7. POLYGONATUM COMMUTATUM (J.A. & J.H.S.) Dietr.; Otto & Dietr. Gartenz, *3*: 223, 1835.

Convallaria commutata J. A. & J. H. S. Syst. *7*: 1671, 1830.

Polygonatum multiforum b *americanum* Hook. Fl. Bor. Am. *2*: 176, 1840, in part.

Polygonatum ellipticum Farwell, Bull. Torr. Club, *42*: 255. 1915.

Polygonatum latifolium commutatum (J. A. & J. H. S.) Baker, Journ. Linn. Soc. Bot. *14*: 555, 1875.

Polygonatum biflorum commutatum (J. A. & J. H. S.) Morong, Mem. Torr. Club *5*: 115, 1894, in part.

Polygonatum biflorum Virginicum Farwell, Bull. Torr. Club *42*: 254, Pl. 15B, 1915 and as to specimens cited, not *P. virginicum* Greene, 1906. In notes on Michigan Flora I I I, Farwell admits this is only *P. commutatum*, which he redescribes as *P. canaliculatum oblongifolium* q.v.

Polygonatum canaliculatum Farwell, Bull. Torr. Club *42*: 255 Pl. 17A, 1915, not *P. canaliculatum* (Muhl.) Pursh, 1814.

Polygonatum biflorum hebetifolium Gates, Bull. Torr. Club *44*: 121 Pl. 5, B, 1917, the plant from Watson, Mo.

Polygonatum canaliculatum oblongifolium Farwell, Notes on the Mich. Flora I I I, 181, 1921.

? *Convallaria parviflora* Poir. Encyc. Suppl. *4*: 29. 1816.

? *Polygonatum parviflorum* (Poir.) Dietr.; Otto & Dietr, Gartenz. *3*: 222, 1835.

TYPE LOCALITY: North America.

New Jersey to Ontario and Michigan, according to Farwell l.c. 256, 1916.

Pennsylvania to Georgia, Canada, Wisconsin, South Dakota, Iowa, Nebraska, Missouri, Kansas and Oklahoma, according to Gates l.c. 123, 1927.

I am referring Poiret's *Convallaria parviflora* to this species, as it appears to me to be only a reduced form of *P. commutatum*. However, an examinotion of the original specimen of Poiret's in the Desfontaine Herbarium in Paris, might show this to be some other species, but numerous collections since Poiret's time have failed to reveal any plant that agrees with Poiret's description.

NEW JERSEY:

Cranberry Lake, *Mackenzie* 2425, September 16, 1906, M. Herb.; Franklin, *Rusby*, August 1875, P. D. & Co. Herb. This specimen is cited by Farwell in Bull. Torr. Club *42*: 256, 1915, as *P. canaliculatum americanum*.

IOWA:

Johnson County, *Fitzpatrick*, June 13, U. of Ill. Herb.; Muscatine, *Mackenzie* 90, May 28, 1892, M. Herb.; Muscatine, *Mackenzie* 90, May 8, 1894, M. Herb.

KANSAS:

Quindaro, *Mackenzie*, May 30, 1897, M. Herb.

MICHIGAN:

Belle Isle, *Farwell*, July 23, 1892, P. D. & Co. Herb. This specimen is labeled *P. biflorum virginicum* by Farwell and the number 1150A, pp. is written in another hand, but this number 1150A belongs to *P. biflorum ovatum*, which was collected at a different date from this.

INDIANA:

Albion, *Deam* 14697, August 25, 1914, D. Herb.; Aurora, *Deam* 16038, June 17, 1915, D. Herb.; Aurora, *Deam* 16109, June 18, 1915, D. Herb.; Bloomington, *Deam* 17506, July 17, 1915, D. Herb.; Bloomington, *Deam* 17507, July 17, 1915, D. Herb.; Bushrod, *Deam* 10682, May 26, 1912, D. Herb.; Cannelton, *Deam* 16626, June 29, 1915, D. Herb.; Cannelton, *Deam* 27146, May 2, 1919, D. Herb.; Carmel, *Deam* 9698, June 18, 1911, D. Herb.; Clark County, *Deam* 27626, May 25, 1919 D. Herb.; Eaton, *Deam* 8532, June 4, 1911, D. Herb.; Elisabeth, *Deam* 23336, June 1, 1917, D. Herb.; Evansville, *Deam* 16749, July 2, 1915, D. Herb.; Grantsbury, *Deam* 27801, June 9, 1919, named *P. conaliculatum oblongifolium* by Farwell; Howe, *Deam* 16749, July 2, 1915, D. Herb.; LaGrange County, *Deam* 20180, June 12, 1916, D. Herb.; Lake Gage, Steuben County, *Deam*, June 16, 1903, D. Herb.; Ligonier, *Deam* 14346, June 26, 1914, D. Herb.; Madison, *Deam* 8500, May 28, 1911, Middlebury, *Deam* 10966, June 4, 1912, D. Herb.; Miller, *Kienbolz*, May 26, 1918, U. of Ill. Herb.; Mongo, *Deam* 26335, September 12, 1918, D. Herb.; Mount Vernon, *Deam* 8322A, May 24, 1911, D. Herb.; New Albany, *Deam* 14002, August 18, 1913, D. Herb.; New Albany, *Deam* 27931, June 13, 1919, D. Herb.; Newberg, *Deam* 25301, June 11, 1918 D. Herb.; New Harmony, *Deam* 909, May 25, 1906, D. Herb.; Patoka, *Deam* 16905, July 16, 1915, D. Herb.; Richmond, *Deam* 13136, June 4, 1913, D. Herb.; Troy, *Deam* 16656, June 30, 1915, D. Herb.; Van Buren, *Deam* 2049, June 16, 1907, D. Herb.; Veedersburg, *Deam*, June 5, 1905, D. Herb; Vevay, *Deam* 13824, July 25, 1913, D. Herb.; Wabash County, *Deam* 2012, June 9, 1907, D. Herb.; Whiting, *Mason Bross*, June 7, 1880, U. of Ill. Herb.

MISSOURI:

Burge Park, *Mackenzie*, May 16, 1896, M. Herb.; Courtney, *Bush* 7996, June 7, 1917, U. of Ill. Herb.; Eolia, *Davis*, August 26, 1916, U. of Ill. Herb.; Hannibal, *Davis*, September 1, 1915, U. of Ill. Herb.; Ilasco, *Davis* 987, August 20, 1911, U. of Ill. Herb.; Neck City, *Palmer* 15872, August 16,

1919, P. Herb.; Oakwood, *Davis*, July 15, 1916, U. of Ill. Herb.; Watson, *Bush*, 527, June 1, 1894, cited by Gates as *P. biflorum hebetifolium*, and figured on Plate 5B, of this new variety, but undoubtedly *P. commutatum;* Webb. City, *Palmer* 15922, August 18, 1919, P. Herb.

OKLAHOMA:

Pawhuska, *Stevens* 1999, August 9, 1913, U. of Ill. Herb.

NORTH DAKOTA:

Devil's Lake, *Lunell*, June 26, 1913, U. of Ill. Herb.; Lake Ibsen, *Lunell*, September 3, 1914, U. of Ill. Herb.

ILLINOIS:

Champaign County, *C. Spruill*, May 29, year not given, U. of Ill. Herb.; Champaign County, *F. C. Gates* 2393, May 21, 1908, U. of Ill. Herb.; Champaign County *Peter Durkin*, May 26, 1876, U. of Ill. Herb.; Carlinsville, *Andrews*, May 19, 1854, U. of Ill. Herb.; Mascoutah, *Welsch*, 1864-1871, U. of Ill Herb.; Mascoutah, *Welsch*, 1862, 1871, U. of Ill. Herb.; Potaka Island, Mount Carmel, *Schneck*, May 13, 1881, U. of Ill. Herb.; Palestine, *F. C. Gates*, 1888, U. of Ill. Herb.; Palestine, *F. C. Gates*, 1888, U. of Ill. Herb.; Peoria, *Brendel*, date not given, U. of Ill. Herb.; Peoria, *Brendel*, date not given, U. of Ill. Herb.; River Forest, Des Plaines Valley, *Agnes Chase*, May 25, 1896, U. of Ill. Herb.; Stark County, *U. H. Chase*, June 20, 1895, U. of Ill. Herb.; Taylorville, *O. DeMotte*, May 1896, U. of Ill. Herb.; Taylorville, *Ruby DeMotte*, June 4, 1897, U. of Ill. Herb.; Urbana, *C. A. Searle*, June 3, 1875, U. of Ill. Herb.; Waukegan, *F. C. Gates* 3025, June 16, 1909, U. of Ill. Herb.; 12th St. Station, Des Plaines Valley, *Agnes Chase*, May 4, 1896, U. of Ill. Herb.

8. POLYGONATUM VIRGINICUM Greene Leaflets, *1*: 181. 1906.

Polygonatum biflorum virginicum (Greene) Farwell, Bull. Torrey Club *42*: 123, 1917.

Stems rather slender 6-10 dm. tall more or less striate, at least below bearing seven to twelve leaves; leaves elliptical ovate elliptical 8-10 cm. long 4-5 cm. wide tapering to an ob-

tuse point, dark green above, glabrous and glaucous beneath, with 13 to 17 more or less conspicuous nerves, the 5 to 7 central ones a little more prominent; peduncles usually 2-flowered, or the lower sometimes 3-flowered, the upper often only 1-flowered; pedicles short, nearly equal; flowers tubular 12-16 mm. long.

TYPE LOCALITY: Bluffs of Holston River, Southeastern Virginia.

Virginia and Michigan according to Farwell, but the Michigan reference applies to *B. commutatum*, and the Virginia reference is taken from Greene. The specimens cited for this species and the one figured as *P. biflorum virginicum* by Farwell, belong to *P. commutatum*. Farwell has since admitted that his Michigan specimens are only *commutatum*.

Virginia and District of Columbia, according to Gates, the Virginia reference taken from Greene. Gates evidently did not understand this species, as it is more nearly related to *P. hebetifolium* than it is to *P. commutatum*.

SPECIMENS EXAMINED:

INDIANA:

Clark County, *Deam* 27603, May 25, 1919, D. Herb.; Salem, *Deam* 23186, May 29, 1917, D. Herb.

9. POLYGONATUM OVATUM (Farwell) n. sp.

Polygonatum biflorum ovatum Farwell, Bull. Torr. Club *42*: 255, 1915.

Polygonatum commutatum ovatum (Farwell) Gates, Bull. Torr. Club *44*: 124, 1917.

Salomonia commutata Farwell, Rep.Com.Parks Detroit *11*: 53, 1900, in part, not *Polygonatum commutatum* (J. A. & J. H. S.) Dietr. 1835.

Stems terete, striate, at least below, 5-10 dm. tall, 4-8 mm. thick, bearing 9 to 13 leaves, and often a large foliaceous sheathing bract 10-15 cm. below the lower leaf; leaves ovate, orbicular, or broadly elliptical, 7.5-10 cm. long 20-40 mm. wide, with 7 to 31 nerves, the 7 to 9 central ones a little more prominent; peduncles stout, 25-35 mm. long, a little

flattened, 2- to 4-flowered; pedicels slender, 5-10 mm. long.

This appears sufficiently distinct in having leaves of a decidedly ovate character, about 8 cm. long and 5 cm. wide, with 7-9 principal veins.

TYPE LOCALITY: Belle Isle, Detroit River, Michigan.

Iowa, Nebraska, Michigan and Oklahoma, according to Gates, l.c. 124. 1917.

SPECIMENS EXAMINED:

MICHIGAN:

Belle Isle, *Farwell* 115A, June, 1892, P.D. & Co. Herb., TYPE of *P. biflorum ovatum*.

INDIANA:

Porterville, *Deam* 28221, July 17, 1919, D. Herb.; Tunnelton, *Deam* 24812, May 16, 1918, D. Herb.

MISSOURI:

Courtney, *Bush* 8000, June 8, 1917, U. of Ill. Herb.; Lake City, *Bush* 7565, June 2, 1915, U. of Ill. Herb.

ILLINOIS:

Taylorville, *Andrews*, May 10, 1899, U. of Ill. Herb.; Taylorville, *Andrews*, May 30, 1899, U. of Ill. Herb.

10. POLYGONATUM GIGANTEUM Dietr.; Otto & Dietr. Gartenz *3*: 222, 1835.

Polygatum multiflorum B americanum Hook. Fl. Bor. Am. 246. 1840, in part.

Polygonatum biflorum Y. *giganteum* (Dietr.) Farwell, Bull. Torr. Club *42*: 256, 1915.

Stems stout, 12-20 dm. high, 1-2 mm. thick, bearing twenty-five to thirty-five leaves; leaves broadly oval, 12-20 cm. long, 8-18 cm. wide, with 40-50 more or less conspicuous nerves; peduncles stout, flattened 5-12.5 cm. in length, bearing two to nine flowers; pedicels 2-5 cm. long; flowers greenish-white, 14 to 20 mm. long; filaments somewhat flattened, smooth.

TYPE LOCALITY: North America.

Michigan, according to Farwell, l.c. 257, 1915.

Maryland, Pennsylvania, Wisconsin, Montana, Nebraska, Missouri, District of Columbia, Ohio, Illinois, Kentucky and Oklahoma, according to Gates, l.c. 124, 1917.

SPECIMENS EXAMINED:

MICHIGAN:

Rochester, *Farwell* 3473, July, 1914, P. D. & Co. Herb.

INDIANA:

Hendricks County, *Deam* 11236, June 22, 1912, D. Herb.; Marengo, *Deam* 27777, June 7, 1919, D. Herb.; Medora, *Deam* 28129, July 15, 1919, D. Herb.; Versailles, *Deam* 13789, July 23, 1913, D. Herb.

ILLINOIS:

Peoria, *McDonald*, July 1904, U. of Ill. Herb.

11. POLYGONATUM MELLEUM Farwell 20th Rept. Mich. Acad. Sci. 170, 1918.

Stems about 6 dm. high, bearing 15 or 16 leaves, leaves broadly ovate, or ovate elliptical, obtuse at the tip, sessile or the lower slightly clasping, 6-8 cm. long, 4-5 cm. wide, with 7-9 principal veins, which are very conspicuous; peduncles short, 1-2 cm. long the upper 2-flowered, the lower 4-flowered; flowers honey-yellow in color, about 12 mm. long and 3 mm. thick.

By the fewer, short, rounded leaves, 2-4-flowered, shorter peduncles, smaller flowers, and lower stem, this plant seems to me to be distinct from any North American species I have seen.

TYPE LOCALITY: Algonac, Michigan.

SPECIMENS EXAMINED:

MICHIGAN:

Algonac, *Farwell* 3974, June 16, 1915, TYPE, in open woods, P. D. & Co. Herb.

12. POLYGONATUM COBRENSIS (W. & S.) Gates, Bull. Torr. Club. 44: 126, 1917.

Salomonia cobrensis W. & S., Contrib. U. S. Nat. Herb. 16, 113, 1913.

TYPE LOCALITY: Copper Mines, Santa Rita, New Mexico.

SPECIMENS EXAMINED:

I have been unable to see any specimens of this recently described species, which appears to be far out of the known range of any other North American species, and is apparently from the description near *P. hebetifolium*, but may only be a much reduced form of *P. commutatum*, which further and more complete collections may determine.

For the more ready appreciation, I append the following comparison of POLYGONATUM names:

FARWELL, 1915.	GATES, 1917.	BUSH.
pubescens *boreale* *boreale*	*pubescens* *pubescens australe* *boreale*	P. PUBESCENS Pursh.
borale	*hirtum*	P. BOREALE Greene.
		P. FARWELLII Bush.
pubescens cuneatum	*pubescens cuneatum*	P. CUNEATUM Greene.
	biflorum	P. BIFLORUM Elliott.
biflorum	*biflorum hebetifolium*	P. HEBETIFOLIUM Bush.
canaliculatum *canaliculatum americanum* *ellipticum* *biflorum virginicum*	*canaliculatum* *parviflorum* *commutatum* *ellipticum*	P. COMMUTATUM Dietr.
	commutatum virginicum	P. VIRGINICUM Greene.
biflorum ovatum	*commutatum ovatum*	P. OVATUM Bush.
canaliculatum giganteum	*giganteum*	P. GIGANTEUM Dietr.
		P. MELLEUM Farwell.
	cobrensis	P. COBRENSIS *Gates.*

A GREAT BLUNDER.

By BENJAMIN FRANKLIN BUSH.

For five or six years past the State representatives of Missouri have been trying to select a flower to represent the State, and have appointed several committees to make the selection; the last one which made the selection to the eternal disgrace of the State of Missouri in-so-far as regards our State Flower.

Several years ago the writer was requested by the Chairman of the Committee to select the State Flower, to co-operate with the Committee and to make suggestions along the line of the selecting, and was finally asked by the chairman of the Committee to select an appropriate flower for the Committee.

My suggestions to the Committee were, that the flower selected should be a Missouri species, and should be a flower that was generally known to the people of Missouri, and particularly to the boys and girls of the State. After several days consideration of the species most eligible for the honor found in Missouri, I finally selected the White Adder's-Tongue, *Erythronium albidum*, often called Spring-Lily and Deer's-Tongue, one of the earliest, and one of the most conspicuous flowers we have in the State, and one that is familiar to every boy and girl of nearly the whole State.

This species was accepted by the Chairman of the Committee to select the State flower, and I supposed the matter settled, until I saw an account in the daily papers a year or so ago, that the Committee had recommended, and the State representatives had adopted, a flower for the State flower. My astonishment was so great when I read the accounts in the evening papers, that I could scarcely believe what I read, for I could not possibly see how any Committee could discard a flower so fittingly acceptable as was the White Adder's Tongue, for something—well, what did the Committee really select.

I called up the Chairman of the Committee on the telephone, and the lady told me that the newspapers had bungled the matter up, that the flower the Committee finally selected was an entirely different thing from the one the papers gave out as the one selected by the Committee. The newspapers throughout the State, and no doubt in other States, stated in their accounts of the selecting of the State Flower, that the committee had selected, and the State representatives had accepted, the Hawthorn for that honor.

The Chairman of the Committee informed me that the Committee had selected the Redhaw for the State Flower, as the one best known, and that the newspapers had changed the name to Hawthorn without their knowledge. I asked the Chairman to tell me what particular Redhaw of the fifty or sixty species that grow in Missouri, the Committee had selected to be the State Flower, and she said that it was the common Redhaw. I told her that there was no common Redhaw, and she said in reply that it was the common Redhaw, around Kansas City, which, if entered upon the records of the committee's report, would approximately fix the identity of the species.

I had a conversation with one other of the Committee to select the State Flower, some time thereafter, and she told me that the Committee had selected the Redhaw as the species to be honored, both on account of its beauty in flower and fruit and commonness throughout the State. In the first part of this statement, I fully agreed, although I could not conceive by the widest stretch of imagination how a tree loaded with white flowers in the Spring, and a load of scarlet fruit in the Autumn, could be a flower; but I took exception to the last part, as it is not a common species in the State, at least nine-tenths of the people in Missouri having never seen it, it being entirely unknown in southeastern and southern Missouri, and absent from Ozark Region.

This lady further informed me when asked how the newspapers had happened to state that it was the Hawthorn that had been selected, that the Committee had thought the word Hawthorn was more appropriate than was the word Redhaw,

and that this name Hawthorn was the same as Redhaw, and sounded better.

At any rate, it has gone down into history so far as the newspapers and the public are concerned, that the Committee to select the State Flower has selected the Hawthorn for that honor, no matter if ninety-nine out of every hundred of the people of this State never saw the Hawthorn or probably never will see it.

There can be no doubt as to the identity of the flowers selected by other states for their State Flowers, notably Ohio, Colorado, Oklahoma, California, Texas, Kansas, Arkansas, Delaware, Louisiana, West Virginia, Minnesota, Montana and Utah. That the newspaper accounts of the selecting of the State Flower for Missouri have been accepted all over the country as applying to the English Hawthorn, one needs only to take up most any catalogue of trees and shrubs offered for sale, to prove this, and I have before me as I write this, "Rock's Garden Book for 1925," in which is cited the English Hawthorn as the Missouri State Flower.

I contend that a flower, or flowering shrub or tree, not generally cultivated in this State, and therefore unknown to the greater part of the people, cannot be selected for the State flower, and that fifty or sixty species of trees and shrubs do not constitute a flower, nor can they be selected as a State Flower. I content and maintain that the act of the Committee in selecting the State Flower, and that of the State representatives in adopting the one selected, transcends any piece of folly it has been my lot to observe. And I further contend and maintain that in-as-much as no specific plant was named, and no Missouri species was named in the newspaper accounts at that time, that Missouri has no State Flower.

INDEX

Acanthichnus cursorius ---195-196
punctatus ------195
tardigradus ----188
trilinearis -----195
Aethyopus ----------187
Allionia Gladewitzii ---------- 29
Alnus incana ---------- 28
Alyssum alyssoides albineum--212
Amblyonyx ----------187
Ambrosia coronopifolia -------44
Anchisauripus exsertus -------193
expansus --186-190-191
Hitchcockii 186-188-189
minusculus ----191
Sillimani --186-197
tuberosus -----187
Anadonta imbecillis ---------221
Anomoepus ---------190, 192, 197
giganteus -------187
minimus ---------196
Anticheiropus hamatus -------186
pilulatus ------192
Arabis laevigata ---------- 31
Archaeopteryx ----------171
Argoides macrodactylus ------197
minimus ----------196
Arisaema triphyllum --------- 25
Aster laevis Linn var. pandu-
ratus ---------- 44
Aster sagittifolius var. glome-
rellus ----------218
Athyrium Filix femina var.
commune ----------203
Aulopora ----------373
confluens ---------380
crebriformis n. sp.--377
dedicata ---------381
elongata ---------380
irregularis --------376
jugalis ----------378
linearis ----------379
modulata ---------375
multiramosa ------374
munda ----------377
noraensis ---------375
Stainbrokii n. sp. --374

Batrachoides nidificans----188-193
Birds ----------297
Botrachopus ----------190
gracilis ---------186
gracilior ----194-196
Botrychium dissectum ------- 23
Bromus secalinus Gladewitzii-- 24
Brontozoum expansum -------186
sillimanium ----------191

Calamite ----------179
Carex deweyana stricta ------ 25
Carleton, Mark Alf., obituary 47
Carunculina parva Cahni ----222
Ceratoxalis cymosa ----------275
stricta ----------275
Chaerophyllum procumbens --- 39
Cheiotherium ----------165-192
Chenopodium boscianum ------ 29
Botrys ------- 29
Corispermum hyssopifolium--- 29
Circaea alpina L. ----------279
Cirsium undulatum forma
album ----------219
Clathropteris rectiusculus ----193
Climatichnites Wilsonii ------197
Commelina longicaulis -------260
verticillata ----------130
Commelina longicaulis --------260

Congress International ____111
Conopsoides larvalis ____196
Conringia orientalis ____ 31
Copeza ____190-193
Corallorrhiza maculata ____ 27
f. flavida____208
f. intermedia_208
Crinoids ____301
Cypripedium bulbosum pubescens ____207

Dactylodites asteroides ____197
Danthonia spicata ____255
Dendrophycus ____196
Dianthus armeria ____ 29
barbatus ____ 29
deltoides ____ 29
Dune, Plants of Indiana ____129

Elymus et seq. ____ 53
canadensis ____310
glaucifolius crescendus ___ 83
robustus ____ 87
Mackenzii ____ 53
philadelphicus ____310-314
var. brachystachys___314
hirsutus ____314
pendulus ____314
robustus ____314
virginicus glabriflorus (Vasey) Bush ____ 62
intermedius ____ 53
jejunus ____ 65
Eragrosti Eragrostis (L) Karst. var. megastachys ____204
subvar. leersioides____306
var. microstachya___306
pilosa (Linn) Beauv. var. carolina ____306
spectabilis var. sparsihirsuta N. var ____306
Eryops ____192
Erythronium albidum____397
Eubrontes ____187
approximatus ____191
divaricatus ____187-193
giganteus ____187-188-192
Euphorbia dentata lancifolia__ 36
var. lancifolia ___216

Ferns ____245
Flower, State of Missouri ____397
Fossils ____164-302-317-373
Fucoides ____181

Genetics, (Book Reviews) principle of ____135
Geology—Sandstone Bird____174
Gorgonia Jacksonis ____179
Grallator _186-187-188-192-195-197
cuneatus ____186-189
gracilis ____189-190-196
rectus ____189
Grasses ____305
Gratiola mesochora ____130
Grammepus ____194
Gryphosaurus ____171

Halysichnus tardigradus ____194
Hawk, Marsh ____297
Hawthorn (Flower) ____402
Helianthus giganteus L. var. microsepalus ____131
resiniferus ____218
verticillatus ____219
Heredity ____303
Hieracium umbellatum scabriusculum ____219

Ichnology ____162
Ichthyosaurus ____179-181
Iguanodon ____177

Juncus Torreyi longipes ____ 26

Koilosoma ____189
nidificans ____196

Lobelia Kalmii var. capillaris 217
Laciniaria Gladewitzii ____ 43
Lactuca scariola var. integrata 46
Lampsilis siliquoidea pepinensis ____223

Leucopitys Strobus ____251
Levisticum Levisticum ____ 39
Liatris scrariosa Deamii ____132
Lithographus hieroglyphicus 194-186
Lycopersicon Lycorpersicum var. commune ____217

Mastodon ____182
Mastodontosaurus ____192
Megalonyx ____182
Megalosaurus ____177
Mitella diphylla efoliata ____213
Monotropa Hypopithys var. rubra ____ 39
Mormolucoides articulatus ____193
Mussel ____89-220
Fisheries ____ 94
List of ____107
Study of the ____113
Myrica Gale ____ 28
subglabra ____ 28

Nautilus ____179
Negundo fraxinifolium ____ 37

Obituary, Mark Alfred Carleton 47
Otozoum ____192
Ornithichnites ____179
giganteus ____174
Orthodactylus floriferus ____194
Oryzopsis pungens ____254
Oxalis corniculata Dillenii ___ 35

Palamopus gracilipes ____195-196
Panax quinquefolium ____ 39
Persicaria mitis Gilib. var. ruderalis ____131
Physalis virginiana f. sanguinea ____ 41
Polygonatum ____385
boreale ____388
cuneatum Greene ___389
Farwellii ____390
giganteum ____398
hebetifolium ____391
ovatum ____397
pubescens ____386
virginicum ____396
Polygonum amphibium var. natans f. emersum ____ 28
Fowleri ____ 28
Portulaca oleracea Linn. var. sativa ____ 29
Plants, Flowering ____245
of Michigan ____199-305
Platypterna Deanii ____192
Plesiornis ____190-197
Pternichnus centipes ____188

Ranunculus delphinifolius Torr. 29
Ribes americanum mesochorum 132
Rosa virginiana ____ 33
Rumex altissimus Wood, var. abortivus ____130
mexicanus ____ 28

Samolus parviflorus ____282
Shrubs—cultivated ____371
of Missouri ____133
Sillimanius gracilior ____194
Sphaeriidae ____220
Sporobolus cryptandrus var. involutus ____205
Stenonyx leteralis ____194
Steropoides diversus ____194
Stigmaria ____179

Tarsodactylus expansus ____195
Taxidermy ____303
Testudo ____179
Trees—cultivated ____371
of Missouri ____133
Triaenopus Baileyi ____195
Trillium cernuum var. declinatum f. Billingtonii ____ 27
cernuum Linn. var. declinatum ____ 26
var declinatum f. Walpoleii ____ 27
erectum ____ 26
var. album ____ 26

Typha angustifolia L. var.....129
Unisulcus 197
Uraspermum aristatum villicante 39
dulce 39
Utterbackia imbecillis fusca ..222
Viola domestica communis 38
latiuscula 37
nephrophylla 37
primulifolia 278
Vitis aestivalis 37
Voltzia 179

Missouri Botanical Garden Library
3 1753 00215 6823

QK1 .A423 1926/27 v.10
The American midland naturalist

QK1 .A423 1926/27 v.10
The American midland naturalist

TITLE

DATE DUE	BORROWER'S NAME	ROOM NUMBER

Missouri Botanical Garden Library
St. Louis, Missouri

BECKTOLD COMPANY
BOOK-BINDERS
210 PINE ST.
St. Louis, Mo.